UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION IX
75 Hawthorne Street
San Francisco, CA 94105-3901

Sylvia Vanderspek, Chief
Air Quality Planning Branch
Air Quality Planning and Science Division
California Air Resources Board
P.O. Box 2815
Sacramento, California 95812

Dear Chief Vanderspek:

The U.S. Environmental Protection Agency (EPA) concurs with the State's request to exclude data showing exceedances of the 2008 and 2015 8-hour O_3 National Ambient Air Quality Standards (NAAQS) on July 26-August 10, 2018 and August 18-October 4, 2020 at monitors in the following nonattainment areas pursuant to the Exceptional Events Rule (EER): Ventura County, CA; Nevada Co. (Western part), CA; Butte County, CA; Calaveras County, CA; San Luis Obispo (Eastern part), CA; Sutter Buttes, CA; Tuscan Buttes, CA; and Tuolumne County, CA. Tables 1 and 2 of enclosure A summarize the 2008 and 2015 O_3 NAAQS exceptional event concurrences for each nonattainment area. Following approval of these exceptional events, the nonattainment areas listed above will have attained the corresponding O_3 NAAQS by their attainment dates based on 2020 design values.

The submittals from California Air Resources Board (CARB), dated September 3, September 17, November 18, and December 8, 2021, included documentation that the July 26-August 10, 2018 and August 18-October 4, 2020 exceedances were caused by exceptional events due to multiple wildfires burning throughout California and Southern Oregon.[1] After thoroughly reviewing the information provided, we agree that the State's submittals meet the demonstration criteria and the schedule and procedural requirements in the EER. The basis for our concurrence is set forth in the enclosure B technical support documents. My staff will enter concurrence flags for these data into the EPA's Air Quality System database.

EPA's concurrence is a preliminary step in the regulatory process for actions that may rely on these data and does not constitute final Agency action. If EPA completes a notice-and-comment rulemaking for an action that is influenced by the exclusion of the O_3 data specified in this concurrence, EPA's concurrence letter and accompanying technical support document would be

[1] CARB submitted a total of four Exceptional Event Demonstrations for Ozone Exceedances: (1) *Eastern Portion of San Luis Obispo County, California August 2018 Wildfire events* (September 3, 2021), (2) *Northern California July-August 2018 Wildfire Events* (September 17, 2021), (3) *Northern California 2020 Wildfire Events* (November 18, 2021), and (4) *Southern California 2020 Wildfire Events* (December 8, 2021).

included in the record as part of the technical basis for the proposed action. If we receive comments, we must consider and respond to those comments before taking final regulatory action. When EPA issues that regulatory action, it is a final Agency action subject to judicial review.

We appreciate the solid technical analysis and collaborative approach used to develop these submittals. We recognize the amount of time and resources represented by these documents and appreciate all of CARB's work to develop technically sound, legally defensible documents under considerable time restraints. If you have any questions or wish to discuss this matter further, please contact me at (415) 972-3183, or Gwen Yoshimura at (415) 947-4134.

Sincerely,

ELIZABETH ADAMS

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Date: 2022.05.04 11:25:36 -07'00'

Elizabeth J. Adams
Director, Air and Radiation Division

Enclosures:

A. Exceptional Event Days Concurred On for 2008 O_3 NAAQS Nonattainment Areas and 2015 O_3 NAAQS Nonattainment Areas
B. Technical Support Documents for EPA Concurrence on July 26-August 10, 2018 and August 18-October 4, 2020 O_3 Exceedances in Northern and Southern California as Exceptional Events

cc (via email): Jin Xu, CARB
Matthew Densberger, CARB
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David Nicholas, Northern Sierra AQMD
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Bill Sandman, Tuolumne County APCD

ENCLOSURE A: Exceptional Event Days Concurred on for 2008 O3 NAAQS Nonattainment Areas and 2015 O3 NAAQS Nonattainment Areas

Table 1. Summary of 8-hour O_3 Exceedances for the 2008 NAAQS (0.075 ppm)

Nonattainment Area	Site Name	Date	8-hour O_3 Concentration (ppm)
Nevada Co. (Western part), CA	Grass Valley (06-057-0005)	7/26/2018	0.083
		7/27/2018	0.082
		7/28/2018	0.078
		7/29/2018	0.078
		7/31/2018	0.101
		8/1/2018	0.098
		8/2/2018	0.101
		8/7/2018	0.084
		8/8/2018	0.095
		8/9/2018	0.093
		8/10/2018	0.086
		8/20/2020	0.122
		8/21/2020	0.104
		9/12/2020	0.086
		9/13/2020	0.081
		9/14/2020	0.079
Ventura County, CA	Simi Valley (06-111-2002)	8/18/2020	0.086
		8/21/2020	0.082
		10/2/2020	0.086
		10/3/2020	0.095
		10/4/2020	0.080

Table 2. Summary of 8-hour O_3 Exceedances for the 2015 NAAQS (0.070 ppm)

Nonattainment Area	Site Name	Date	8-hour O_3 Concentration (ppm)
Calaveras County, CA	San Andreas – Gold Strike (06-009-0001)	7/28/2018	0.071
		7/30/2018	0.077
		7/31/2018	0.086
		8/2/2018	0.074
		8/5/2018	0.078
		8/8/2018	0.071
		8/9/2018	0.081
		8/10/2018	0.076
Butte County, CA	Paradise (06-007-0007)	7/26/2018	0.075
		7/27/2018	0.080
		7/28/2018	0.079
		7/30/2018	0.074
		7/31/2018	0.086
		8/1/2018	0.098
		8/2/2018	0.081
		8/7/2018	0.078
		8/8/2018	0.076
		8/9/2018	0.088
		8/10/2018	0.084

Sutter Buttes, CA	Sutter Buttes (06-101-0004)	7/28/2018	0.08
		7/29/2018	0.075
		7/30/2018	0.083
		7/31/2018	0.082
		8/1/2018	0.082
		8/3/2018	0.074
		8/7/2018	0.075
		8/9/2018	0.079
		8/10/2018	0.077
		8/21/2020	0.090
		8/22/2020	0.089
Tuolumne County, CA	Sonora (06-109-0005)	7/28/2018	0.079
		7/29/2018	0.079
		7/30/2018	0.076
		7/31/2018	0.078
		8/2/2018	0.078
		8/4/2018	0.074
		8/5/2018	0.084
		8/6/2018	0.08
		8/8/2018	0.087
		8/9/2018	0.074
		8/10/2018	0.079
		8/20/2020	0.081
		8/21/2020	0.083
		8/22/2020	0.081
Tuscan Buttes, CA	Tuscan Butte (06-103-0004)	7/27/2018	0.076
		7/31/2018	0.081
		8/1/2018	0.082
		8/2/2018	0.073
		8/3/2018	0.077
		8/7/2018	0.071
		8/8/2018	0.078
		8/9/2018	0.087
		8/10/2018	0.085
San Luis Obispo (Eastern Part), CA	Red Hills (06-079-8005)	8/3/2018	0.073
		8/4/2018	0.072
		8/6/2018	0.071
		8/7/2018	0.071
		8/9/2018	0.073
		8/20/2020	0.076
		8/21/2020	0.106
		9/30/2020	0.075
		10/1/2020	0.081
		10/2/2020	0.081

ENCLOSURE B

Technical Support Documents for EPA Concurrence on July 26-August 10, 2018 and August 18-October 4, 2020 O_3 Exceedances in Northern and Southern California as Exceptional Events

16 Technical Support Documents included in this enclosure:

1. Technical Support Document for EPA Concurrence on O_3 Exceedances Measured in the Western Part of Nevada County (Grass Valley, CA) on July 26-29, July 31-August 2, and August 7-10, 2018, as an Exceptional Event
2. Technical Support Document for EPA Concurrence on O_3 Exceedances Measured in the Western Part of Nevada County (Grass Valley, CA) on August 20-21, 2020, as an Exceptional Event
3. Technical Support Document for EPA Concurrence on O_3 Exceedances Measured in the Western Part of Nevada County (Grass Valley, CA) on September 12-14, 2020, as an Exceptional Event
4. Technical Support Document for EPA Concurrence on O_3 Exceedance Measured in Ventura County, California on August 18, 2020 as an Exceptional Event
5. Technical Support Document for EPA Concurrence on O_3 Exceedance Measured in Ventura County, California on August 21, 2020 as an Exceptional Event
6. Technical Support Document for EPA Concurrence on O_3 Exceedances Measured in Ventura County, California on October 2-4, 2020 as an Exceptional Event
7. Technical Support Document for EPA Concurrence on O_3 Exceedances Measured in Calaveras County, California on July 28, July 30-31, August 2, August 5, August 8-10, 2018 as an Exceptional Event
8. Technical Support Document for EPA Concurrence on O_3 Exceedances Measured in Butte County (Paradise), California on July 26-28, July 30-August 2, and August 7-10, 2018 as an Exceptional Event
9. Technical Support Document for EPA Concurrence on O_3 Exceedances Measured in Sutter Buttes, California on July 28-August 1, August 3, August 7, and August 9-10, 2018 as an Exceptional Event
10. Technical Support Document for EPA Concurrence on O_3 Exceedances Measured in Sutter Buttes, California on August 21-22, 2020 as an Exceptional Event
11. Technical Support Document for EPA Concurrence on O_3 Exceedances Measured in Tuolumne County, California on July 28-31, August 2, August 4-6, and August 8-10, 2018 as an Exceptional Event
12. Technical Support Document for EPA Concurrence on O_3 Exceedances Measured in Tuolumne County, California on August 20-22, 2020 as an Exceptional Event
13. Technical Support Document for EPA Concurrence on O_3 Exceedances Measured in Tuscan Buttes (Tehama County), California on July 27, July 31-August 3, and August 7-10, 208 as an Exceptional Event
14. Technical Support Document for EPA Concurrence on O_3 Exceedances Measured in the Eastern Part of San Luis Obispo County, California on August 3-4, August 6-7, and August 9, 2018 as an Exceptional Event

15. Technical Support Document for EPA Concurrence on O_3 Exceedances Measured in the Eastern Part of San Luis Obispo County, California on August 20-21, 2020 as an Exceptional Event
16. Technical Support Document for EPA Concurrence on O_3 Exceedances Measured in the Eastern Part of San Luis Obispo County, California on September 30-October 2, 2020 as an Exceptional Event

ENCLOSURE: TECHNICAL SUPPORT DOCUMENT FOR EPA CONCURRENCE ON O_3 EXCEEDANCES MEASURED IN THE WESTERN PART OF NEVADA COUNTY (GRASS VALLEY, CA) ON JULY 26-29, JULY 31-AUGUST 2, AND AUGUST 7-10, 2018, AS AN EXCEPTIONAL EVENT

On September 17, 2021, the California Air Resources Board (CARB) submitted an exceptional event demonstration for exceedances of the 2008 8-hour ozone (O_3) National Ambient Air Quality Standards (NAAQS) of 0.075 parts per million (ppm) that occurred at the Grass Valley-Litton Building monitoring site ("the Grass Valley monitoring site") on July 26-29, July 31-August 2, and August 7-10, 2018.[1] The demonstration submitted by CARB stated that the exceedances measured at the Grass Valley monitoring site between July 26 and August 10, 2018 were caused by multiple wildfires burning in Northern and Central California and Southern Oregon, namely the Ranch, River, Carr, Donnell, and Ferguson fires.[2] Under the Exceptional Events Rule, air agencies can request the exclusion of event-influenced data, and the EPA can agree to exclude these data, from the data set used for certain regulatory decisions. The remainder of this document summarizes the Exceptional Events Rule requirements, the event and the EPA's review process.

EXCEPTIONAL EVENTS RULE REQUIREMENTS

The EPA promulgated the Exceptional Events Rule in 2007, pursuant to the 2005 amendment of Clean Air Act (CAA) Section 319. In 2016, the EPA finalized revisions to the Exceptional Events Rule. The 2007 Exceptional Events Rule and 2016 Exceptional Events Rule revisions added sections 40 CFR §50.1(j)-(r); §50.14; and §51.930 to title 40 of the Code of Federal Regulations (CFR). These sections contain definitions, criteria for EPA approval, procedural requirements, and requirements for air agency demonstrations. The EPA reviews the information and analyses in the air agency's demonstration package using a weight of evidence approach and decides to concur or not concur. The demonstration must satisfy all of the Exceptional Events Rule criteria for the EPA to concur with excluding the air quality data from regulatory decisions.

Under 40 CFR §50.14(c)(3)(iv), the air agency demonstration to justify exclusion of data must include:

A. "A narrative conceptual model that describes the event(s) causing the exceedance or violation and a discussion of how emissions from the event(s) led to the exceedance or violation at the affected monitor(s);"

B. "A demonstration that the event affected air quality in such a way that there exists a clear causal relationship between the specific event and the monitored exceedance or violation;"

[1] "Exceptional Events Demonstration for Ozone Exceedances; Northern California; July-August 2018 Wildfire Events," California Air Resources Board (September 17, 2021) ("demonstration"). The demonstration addresses multiple events and exceedances measured in Northern California in July – August 2018. The EPA's evaluation of the information presented in the demonstration is reflected in seven separate TSDs, grouped by nonattainment area affected.
[2] See demonstration, p. 72.

C. "Analyses comparing the claimed event-influenced concentration(s) to concentrations at the same monitoring site at other times" to support requirement (B) above;

D. "A demonstration that the event was both not reasonably controllable and not reasonably preventable;" and

E. "A demonstration that the event was a human activity that is unlikely to recur at a particular location or was a natural event."[3]

In addition, the air agency must meet several procedural requirements, including:

1. submission of an Initial Notification of Potential Exceptional Event and flagging of the affected data in the EPA's Air Quality System (AQS) as described in 40 CFR §50.14(c)(2)(i),

2. completion and documentation of the public comment process described in 40 CFR §50.14(c)(3)(v), and

3. implementation of any relevant mitigation requirements as described in 40 CFR §51.930.

For data influenced by exceptional events to be excluded from use in initial area designations, air agencies must also meet the initial notification and demonstration submission deadlines specified in Table 2 to 40 CFR §50.14. We include below a summary of the Exceptional Events Rule criteria, including those identified in 40 CFR §50.14(c)(3)(iv).

Regulatory Significance

The 2016 Exceptional Events Rule includes regulatory language that applies the provisions of CAA section 319 to a specific set of regulatory actions. As identified in 40 CFR §50.14(a)(1)(i), these regulatory actions include initial area designations and redesignations; area classifications; attainment determinations (including clean data determinations); attainment date extensions; findings of State Implementation Plan (SIP) inadequacy leading to a SIP call; and other actions on a case-by-case basis as determined by the Administrator. Air agencies and the EPA should discuss the regulatory significance of an exceptional events demonstration during the Initial Notification of Potential Exceptional Event prior to the air agency submitting a demonstration for the EPA's review.

Narrative Conceptual Model

The 2016 Exceptional Events Rule directs air agencies to submit, as part of the demonstration, a narrative conceptual model of the event that describes and summarizes the event in question and provides context for analyzing the required statutory and regulatory technical criteria. Air agencies may support the narrative conceptual model with summary tables or maps. For wildfire O_3 events, the EPA recommends that the narrative conceptual model also discuss the interaction

[3] A natural event is further described in 40 CFR 50.1(k) as "an event and its resulting emissions, which may recur at the same location, in which human activity plays little or no direct causal role. For purposes of the definition of a natural event, anthropogenic sources that are reasonably controlled shall be considered to not play a direct role in causing emissions."

of emissions, meteorology, and chemistry of event and non-event O_3 formation in the area, and, under 40 CFR §50.14(a)(1)(i), must describe the regulatory significance of the proposed data exclusion.

Clear Causal Relationship and Supporting Analyses

The EPA considers a variety of evidence when evaluating whether there is a clear causal relationship between a specific event and the monitored exceedance or violation. For wildfire O_3 events, air agencies should compare the O_3 data requested for exclusion with seasonal and annual historical concentrations at the air quality monitor to establish a clear causal relationship between the event and monitored data. In addition to providing this information on the historical context for the event-influenced data, air agencies should further support the clear causal relationship criterion by demonstrating that the wildfire's emissions were transported to the monitor, that the emissions from the wildfire influenced the monitored concentrations, and, in some cases, air agencies may need to provide evidence of the contribution of the wildfire's emissions to the monitored O_3 exceedance or violation.

For wildfire O_3 events, the EPA has published a guidance document that provides three different tiers of analyses that apply to the "clear causal relationship" criterion within an air agency's exceptional events demonstration.[4] This tiered approach recognizes that some wildfire events may be more clear and/or extreme and, therefore, require relatively less evidence to satisfy the rule requirements. If a wildfire/O_3 event satisfies the key factors for either Tier 1 or Tier 2 clear causal analyses, then those analyses are the only analyses required to support the clear causal relationship criterion within an air agency's demonstration for that particular event. Other wildfire/O_3 events will be considered based on Tier 3 analyses.

- Tier 1: Wildfires that clearly influence monitored O_3 exceedances or violations when they occur in an area that typically experiences lower O_3 concentrations.
    - *Key Factor*: seasonality and/or distinctive level of the monitored O_3 concentration. The event-related exceedance occurs during a time of year that typically has no exceedances, or is clearly distinguishable (*e.g.*, 5-10 parts per billion (ppb) higher) from non-event exceedances.
    - In these situations, O_3 impacts should be accompanied by clear evidence that the wildfire's emissions were transported to the location of the monitor.

- Tier 2: The wildfire event's O_3 influences are higher than non-event related concentrations, and fire emissions compared to the fire's distance from the affected monitor indicate a clear causal relationship.
    - *Key Factor 1*: fire emissions and distance of fire(s) to affected monitoring site location(s). Calculated fire emissions of nitrogen oxides (NO_x) and reactive-volatile organic compounds (VOC) in tons per day (Q) divided by the distance from the fire to the monitoring site (D) should be equal to or greater than 100 tons per day/kilometers ($Q/D \geq 100$ tpd/km). The guidance document provides additional information on the calculation of Q/D.

[4] "Guidance on the Preparation of Exceptional Events Demonstrations for Wildfire Events that May Influence Ozone Concentrations" (September 2016) ("wildfire O_3 guidance document").

- *Key Factor 2*: comparison of the event-related O_3 concentration with non-event related high O_3 concentrations. The exceedance due to the exceptional event:
  - is in the 99th or higher percentile of the 5-year distribution of O_3 monitoring data, OR
  - is one of the four highest O_3 concentrations within 1 year (among those concentrations that have not already been excluded under the Exceptional Events Rule, if any).
- In addition to the analysis required for Tier 1, the air agency should supply additional evidence to support the weight of evidence that emissions from the wildfire affected the monitored O_3 concentration.

- Tier 3: The wildfire does not fall into the specific scenarios (i.e., does not meet the key factors) that qualify for Tier 1 or Tier 2, but the clear causal relationship criterion can still be satisfied by a weight of evidence showing.
  - In addition to the analyses required for Tier 1 and Tier 2, an air agency may further support the clear causal relationship with additional evidence that the fire emissions caused the O_3 exceedance.

Not Reasonably Controllable or Preventable

The Exceptional Events Rule requires that air agencies establish that the event be both not reasonably controllable and not reasonably preventable at the time the event occurred. This requirement applies to both natural events and events caused by human activities; however, it is presumed that wildfires on wildland will satisfy both factors of the "not reasonably controllable or preventable" element unless evidence in the record clearly demonstrates otherwise.[5]

Natural Event

According to the CAA and the Exceptional Events Rule, an exceptional event must be "an event caused by human activity that is unlikely to recur at a particular location *or* a natural event" (emphasis added). The 2016 Exceptional Events Rule includes in the definition of wildfire that "[a] wildfire that predominantly occurs on wildland is a natural event." Once an agency provides evidence that a wildfire on wildland occurred and demonstrates that there is a clear causal relationship between the measurement under consideration and the event, the EPA expects minimal documentation to satisfy the "human activity that is unlikely to recur at a particular location or a natural event" element. The EPA will address wildfires on other lands on a case-by-case basis.

EPA REVIEW OF EXCEPTIONAL EVENTS DEMONSTRATION

On March 15, 2021, CARB submitted an Initial Notification of a potential Exceptional Event for numerous exceedances of the 2008 O_3 NAAQS that occurred at the Grass Valley monitoring site

[5] A wildfire is defined in 40 CFR 50.1(n) as "any fire started by an unplanned ignition caused by lightning; volcanoes; other acts of nature; unauthorized activity; or accidental, human-caused actions, or a prescribed fire that has developed into a wildfire. A wildfire that predominantly occurs on wildland is a natural event." Wildland is defined in 40 CFR 50.1(o) as "an area in which human activity and development are essentially non-existent, except for roads, railroads, power lines, and similar transportation facilities. Structures, if any, are widely scattered."

within Western Nevada County between July 26 and August 10, 2018.[6] On September 17, 2021, CARB submitted an exceptional event demonstration for 11 exceedances of the 2008 O_3 NAAQS that occurred at the Grass Valley monitoring site between July 26, 2018, and August 10, 2018.[7]

Regulatory Significance

The EPA determined that data exclusion of certain exceedances referenced in the Initial Notification may have a regulatory significance for the determination of attainment by the attainment date of July 20, 2021 for the Nevada County (Western part), California Serious nonattainment area for the 2008 O_3 NAAQS, and worked with CARB to identify the relevant exceedances and monitoring sites affected.[8] Table 1 summarizes the exceedances measured at the Grass Valley monitoring site that CARB included in the demonstration.

Table 1: 2008 O_3 NAAQS Exceedance Summary

Exceedance Date	Monitoring Site Name	AQS ID	8-hour Avg. (ppm)
July 26, 2018	Grass Valley	06-057-0005	0.083
July 27, 2018	Grass Valley	06-057-0005	0.082
July 28, 2018	Grass Valley	06-057-0005	0.078
July 29, 2018	Grass Valley	06-057-0005	0.078
July 31, 2018	Grass Valley	06-057-0005	0.101
August 1, 2018	Grass Valley	06-057-0005	0.098
August 2, 2018	Grass Valley	06-057-0005	0.101
August 7, 2018	Grass Valley	06-057-0005	0.084
August 8, 2018	Grass Valley	06-057-0005	0.095
August 9, 2018	Grass Valley	06-057-0005	0.093
August 10, 2018	Grass Valley	06-057-0005	0.086

Narrative Conceptual Model

The demonstration submitted by CARB provided a narrative conceptual model in the sections of the demonstration titled "Overview/Introduction," "Background," and "Narrative Conceptual Model – July 26-August 10, 2018" to describe how emissions from wildfires in Northern and Central California and Southern Oregon caused the O_3 exceedances at the Grass Valley monitoring site. The Overview/Introduction and Background sections of the demonstration provided information supporting the narrative conceptual model including characteristics of the nonattainment area, such as geography, topography, meteorology, typical non-event O_3 formation conditions and patterns, seasonal O_3 variations, the ambient O_3 monitoring network, and emissions of O_3 precursors.[9]

[6] See email from Sylvia Vanderspek, CARB, to Gwen Yoshimura, EPA Region 9, dated March 15, 2021.
[7] See letter from Michael Benjamin, CARB, to Elizabeth Adams, EPA Region 9, dated September 17, 2021.
[8] See letter from Elizabeth Adams, EPA Region 9, to Sylvia Vanderspek, CARB, dated April 21, 2021.
[9] See demonstration, pp. 1-9, 10-26.

The narrative conceptual model described characteristics of the event. This included a general description of the occurrence of wildfires in Northern and Central California and Southern Oregon and specific descriptions of major wildfires active between July 13, 2018, and August 10, 2018, including the name, cause, start date, containment date, location, and total acreage burned for each fire.[10] The narrative conceptual model also included figures displaying meteorological conditions on the dates of the fires and Hybrid Single Particle Lagrangian Integrated Trajectory (HYSPLIT) modeling results. The HYSPLIT trajectory modeling results were presented with satellite imagery, Hazard and Mapping System (HMS) satellite-derived smoke layers, and meteorological analyses to support that wildfire emissions were transported to the Grass Valley monitoring site on the exceptional event dates requested for exclusion. Along with these graphics, the narrative conceptual model included narrative descriptions of how meteorological conditions affected the behavior of air and smoke in the areas of the wildfires on July 26-29, July 30-31, August 1-2, August 6-9, and August 10-11 in 2018.[11]

The narrative conceptual model included charts showing the concentrations of O_3 and particulate matter less than or equal to 2.5 microns in aerodynamic diameter ($PM_{2.5}$) between July 15, 2018, and August 15, 2018 at the Grass Valley monitoring site and suggested that elevated $PM_{2.5}$ concentrations coinciding with the timing of the wildfires and elevated O_3 concentrations support the presence of wildfire smoke.[12] The narrative conceptual model also included charts of 8-hour O_3 design values and annual fourth high 8-hour average O_3 concentrations at the Grass Valley monitoring site.[13] The demonstration addressed the regulatory significance of the exceptional event by noting that the exclusion of wildfire events in 2018 and 2020 would affect a determination of attainment for the Nevada County (Western part), California Serious nonattainment area for the 2008 O_3 NAAQS.[14]

The narrative conceptual model also included daily meteorological data (temperatures and wind speeds) along with 1-hour and 8-hour O_3 concentrations from the Grass Valley monitoring site to show that weather patterns observed at the Grass Valley monitoring site on exceptional event days were not generally more favorable for O_3 formation than on non-event days in July 2018 and August 2018.[15] The demonstration concluded that O_3 directly related to wildfire smoke influenced the exceedances as opposed to unusual weather. The narrative conceptual model included descriptions of air quality advisories issued by the Northern Sierra Air Quality Management District and the Greater Portola Blog as well as examples of social media coverage of the 2018 wildfires in Northern and Central California.[16]

Overall, the demonstration contained the elements required for inclusion in the narrative conceptual model portion of the exceptional events demonstration.

[10] See demonstration, pp. 27-40.
[11] See demonstration, pp. 40-61.
[12] See demonstration, pp. 72-73.
[13] See demonstration, pp. 73-74.
[14] See demonstration, pp. 2, 4, 7.
[15] See demonstration, pp. 74, 78.
[16] See demonstration, pp. 79-82.

Table 2: Documentation of the Narrative Conceptual Model

Exceedance Date	Demonstration Citation	Quality of Evidence	Criterion Met?
July 26-29, July 31-August 2, August 7-10, 2018	"Overview/Introduction": pp. 1-9 "Background": pp. 10-26 "Narrative Conceptual Model – July 26-August 10, 2018": pp. 27-61, 72-74, 78-82	Sufficient	Yes

Clear Causal Relationship

The demonstration included several analyses to support a clear causal relationship between the wildfire events and the monitored exceedances. These analyses were presented in the "Clear Causal Relationship" section of the demonstration.

Comparison with historical concentrations

The demonstration included a comparison with historical concentrations, as required by 40 CFR §50.14(c)(3)(iv)(C). The demonstration compared O_3 concentrations at the Grass Valley monitoring site on the 2018 wildfire exceptional event days to historical non-event O_3 concentrations between 2013 and 2018. This included a graph of daily maximum 8-hour average concentrations over the six-year period by day of year, the level of the 2008 O_3 NAAQS, and the 99th percentile value at the site. The demonstration noted that the exceptional events occurred during the time of year when O_3 concentrations tend to be higher at this monitoring site and that the exceptional event exceedances at the Grass Valley monitoring site are not clearly distinguishable from non-event exceedances as defined by guidance.[17]

Tier 1: Key Factor

To meet the key factor for a Tier 1 analysis, exceedances should be clearly higher than other non-event related exceedances or occur during a time of year that typically experiences no exceedances. The exceedances identified in this demonstration occurred within the O_3 season when exceedances have historically been observed at the Grass Valley monitoring site. The O_3 concentrations at Grass Valley on event days identified in this demonstration do not exceed non-event exceedance concentrations by at least five ppb.[18] Therefore, the exceedances do not meet the Tier 1 Key Factor, and additional evidence beyond a Tier 1 analysis is needed to support the clear causal relationship.

Tier 2: Key Factors

The demonstration included an evaluation of the Tier 2 Key Factors. For Tier 2 Key Factor 1, the demonstration provided an analysis of fire emissions (Q) and distance (D) of the wildfires to the monitoring site locations. The Q/D value is generally calculated by dividing wildfire emissions (in tons per day) by the distance between the wildfire and the monitoring site (in kilometers [km]). Daily Q/D values were calculated by the EPA using Community Multiscale Air Quality (CMAQ) modeling system daily wildland fire emissions input files. The resulting calculations were shared with CARB to assist in demonstration development. CMAQ input files included daily total emissions of nitrogen oxide (NO), nitrogen dioxide (NO_2), and reactive organic gases (ROG) at release points corresponding to wildfire locations. Q/D was calculated for each CMAQ

[17] See demonstration, pp. 83-84, 90.
[18] See demonstration, p. 90.

input release point by calculating the distance between release point locations and gridded receptor locations and dividing the associated fire's daily emissions by this distance. An aggregated daily Q/D was then calculated by summing the individual Q/D values for each release point. An "effective Q/D" value was then calculated at monitoring site receptor locations by accounting for periods where multiple days of wildfire smoke buildup impacted the monitoring site for up to three total days; the dates to include in each daily "effective Q/D" were based on meteorology and transport analyses, with the rationale further outlined in the demonstration.[19] The distance-weighted sums for all dates requested as exceptional events at the Grass Valley monitoring site except for August 10, 2018, are greater than the Tier 2 Key Factor 1 screening value of 100 tons per day of NO_X and VOC per km.[20] Therefore, the event exceedances for all dates except for August 10, 2018, meet Tier 2 Key Factor 1. The demonstration noted that enhanced wildfire impacts for August 10, 2018 are also considered qualifying because they occurred at the end of a prolonged event; wildfire emissions were decreasing but remained elevated, and residual local effects continued to impact O_3 concentrations at the monitoring site.[21] Since all of the dates but one meet Tier 2 Key Factor 1, and the date that does not meet this factor follows several days of requested exclusions that do meet the Key Factor, it is appropriate to consider all days included in the demonstration as meeting Tier 2 Key Factor 1 for the purposes of determining the appropriate tier for this demonstration.

For Tier 2 Key Factor 2, the demonstration included evidence that the exceedances, including August 10, 2018, are at or above the 99th percentile from the past five years of O_3 season data (2013-2017) or among the four highest concentrations measured at the site in 2018. In the demonstration, CARB determined an "adjusted 4th high" corresponding to the 4th highest non-event exceedance monitored in 2018, excluding the exceedances included in the demonstration.[22] CARB noted that dates impacted by exceptional events should not count against the tally of the four highest O_3 concentrations measured in 2018 because these exceedances were caused by contributions from wildfire emissions.[23] This rationale is supported given that the purpose of the test is to show that the exceedances are high compared to non-event data. Since the excluded dates are all included in the demonstration being evaluated in this TSD, each individual date would not count towards the four highest concentrations if concurred on by the EPA. As shown in Table 4-11 of the demonstration, the monitored O_3 concentrations on all dates, including August 10, 2018, requested as exceptional events exceed the adjusted 4th high O_3 concentration at the Grass Valley monitoring site in 2018.[24] Therefore, the event exceedances meet Tier 2 Key Factor 2.

Based on the analysis of the Key Factors for Tier 2, the EPA's wildfire O_3 guidance document indicates that a Tier 2 analysis is appropriate for this event. As described below, the demonstration included the required elements for a Tier 2 clear causal relationship analysis based on the EPA's wildfire O_3 guidance document. This includes evidence to support that (1) wildfire

[19] See demonstration, pp. 92-93, 97-98.
[20] See demonstration, pp. 97-98.
[21] See demonstration, p. 97.
[22] See demonstration, pp. 103-104.
[23] See demonstration, pp. 98-99.
[24] See demonstration, pp. 103-104.

emissions were transported from the wildfire to the monitor; and (2) wildfire emissions affected the monitor.

Evidence of transport of wildfire emissions from the wildfire to the monitor

The demonstration presented analyses in the Narrative Conceptual Model chapter using backward trajectory and forward trajectory modeling.[25] HYSPLIT modeling was used to determine back trajectories and forward trajectories that estimate the movement of air parcels and smoke during the event period.[26] HYSPLIT back trajectories showing the likely path of air parcels for 36 hours prior to the time of peak concentrations on July 27, August 1, August 7, and August 10, 2018 at three elevations (100 meters (m), 500 m, and 1,000 m) were overlaid on National Oceanic and Atmospheric Administration (NOAA) Hazard and Mapping System (HMS) Fire and Smoke Product imagery. HYSPLIT forward trajectories showing the most likely center path of air parcels for 36 hours beginning at the wildfire location on July 27, July 30, August 7, and August 10, 2018 were overlaid on satellite imagery to provide a visual analysis of whether smoke emitted from the fires may have impacted ambient O_3 concentrations at the Grass Valley monitoring site. The back trajectories from the Grass Valley monitoring site pass through areas of heavy smoke and occasionally near the fire locations, while the forward trajectories approach the monitoring site. The back trajectory and forward trajectory analyses support that wildfire emissions were transported to the Grass Valley monitoring site on the days requested for exclusion as exceptional events.

Evidence that the wildfire emissions affected the monitor

The demonstration provided analyses in Sections II and III of the Narrative Conceptual Model chapter of the demonstration, as well as Section III of the Clear Causal Relationship chapter of the demonstration, as evidence that wildfire emissions affected the Grass Valley monitoring site on the exceptional event dates requested for exclusion. In particular, the demonstration included evidence of a correlation between O_3 and $PM_{2.5}$ concentrations in Figure 3-42.[27] This correlation provides strong evidence that the increase in O_3 resulted from the impact of wildfire emissions in the nonattainment area, as shown by the simultaneous, large increases in $PM_{2.5}$ as compared to the days preceding and following the event. The demonstration also included figures comparing the daily diurnal pattern of O_3 concentrations on each exceptional event day to hourly diurnal O_3 percentiles between 2013 and 2017.[28] For many of the exceptional event days included in the demonstration, O_3 concentrations showed abnormal patterns compared to typical daily diurnal O_3 profiles at the Grass Valley monitoring site. Abnormalities observed in Figures 4-55 through 4-66 of the demonstration included sustained elevated O_3 concentrations over multiple days as well as unusual timing of spikes and dips in O_3 concentrations.

The demonstration included charts of daily $PM_{2.5}$ concentrations at the Grass Valley monitoring site as well as charts showing concentrations of biomass burning indicators at nearby monitoring sites. Figure 4-67 of the demonstration showed elevated $PM_{2.5}$ concentrations on the exceptional event days, consistent with wildfire smoke and emissions directly impacting the monitoring site at ground level on the exceptional event days.[29] The demonstration also included black carbon

[25] See demonstration, p. 105.
[26] See demonstration, pp. 41-61.
[27] See demonstration, p. 73.
[28] See demonstration, pp. 130-136.
[29] See demonstration, pp. 136-137.

and biomass burning indicator analyses. Figure 4-70 of the demonstration showed the concentrations of three biomass burning indicators (levoglucosan, mannosan, and galactosan) measured at Portola, Chico, and Sacramento between July 1 and August 31, 2018. Although these sites do not consistently monitor during the summer months, they were active during the summer of 2018.[30] The two samples collected during the time addressed in this demonstration, on July 31 and August 6, 2018, show concentrations across all three sites that are among the highest concentrations measured during the period in the figures. Elevated concentrations of these biomass burning indicators during the time of the requested exceptional events support the presence of wildfire smoke in the area. The demonstration also included a map of black carbon smoke plumes associated with the Carr, Mendocino Complex (i.e., Ranch and River fires), and Ferguson Fires, and noted that wildfires are a major source of black carbon emissions in California.[31] The map shows higher concentrations of atmospheric black carbon over Nevada County, adjacent to the Mendocino Complex, which supports evidence of wildfire smoke at the Grass Valley monitoring station during the time of the exceedances.

As additional evidence to support that wildfire emissions affected the Grass Valley monitoring site, the demonstration included the following figures: (1) a special weather statement issued by the National Weather Service in Sacramento, CA, on August 4, 2018, related to wildfire smoke (Figure 4-73) describing dense smoke and falling ash in the Northern California valleys; and (2) language from the NOAA Smoke Text Product on July 26, 2018, and August 5, 2018, describing smoke plume coverage in the Western United States (Figure 4-74).[32] Both the weather statement and NOAA Smoke Text Product generally suggest that smoke from the Mendocino Complex and Carr wildfires may have reached the ground and impacted the Grass Valley monitoring station during the time of the exceedances.

Conclusion

The analyses included in the demonstration, specifically comparison to historical concentrations, Tier 2 Key Factors, Q/D analyses, HYSPLIT modeling and satellite observations of smoke, correlation between $PM_{2.5}$ and O_3 during the event dates, evidence of impacts to hourly O_3 data, presence of biomass burning tracers, and related NWS and NOAA statements on smoke, sufficiently demonstrate a clear causal relationship between the emissions generated by the 2018 wildfires in Northern and Central California and Southern Oregon and the exceedances measured at the Grass Valley monitoring site.

Table 3: Documentation of the Clear Causal Relationship criterion

Exceedance Date	**Demonstration Citation**	**Quality of Evidence**	**Criterion Met?**
July 26-29, July 31-August 2, August 7-10, 2018	"Narrative Conceptual Model – July 26-August 10, 2018": pp. 27-82 "Clear Causal Relationship": pp. 83-84, 90-93, 97-99, 103-105, 130, 136-144	Sufficient	Yes

[30] See demonstration, pp. 138-140.
[31] See demonstration, pp. 140-141.
[32] See demonstration, pp. 141-144.

Not Reasonably Controllable or Preventable

The Exceptional Events Rule presumes that wildfire events on wildland are not reasonably controllable or preventable [40 CFR §50.14(b)(4)]. The demonstration provided evidence that the wildfire event meets definition of wildfire [40 CFR §50.1(n)]. Specifically, the demonstration included maps and descriptions of the wildfires, along with figures showing wildfire boundaries overlaid upon land ownership and wildland-urban interface layers to demonstrate that the fires occurred on wildland or in the urban/wildland interface.[33] The demonstration described that CARB is not aware of any evidence clearly demonstrating that prevention or control efforts beyond those actually made would have been reasonable.[34] Therefore, the documentation provided sufficiently demonstrates that the event was not reasonably controllable and not reasonably preventable.

Table 4: Documentation of the Not Reasonably Controllable or Preventable criterion

Exceedance Date	Demonstration Citation	Quality of Evidence	Criterion Met?
July 26-29, July 31-August 2, August 7-10, 2018	"Narrative Conceptual Model – July 26-August 10, 2018": pp. 27-40 "Not Reasonably Controllable and/or Not Reasonably Preventable": p. 145	Sufficient	Yes

Natural Event

The definition of "wildfire" at 40 CFR §50.1(n) states, "A wildfire that predominantly occurs on wildland is a natural event." As previously described, the demonstration included documentation that the event meets the definition of a wildfire and occurred predominantly on wildland and has therefore shown that the event was a natural event.

Table 5: Documentation of the Natural Event criterion

Exceedance Date	Demonstration Citation	Quality of Evidence	Criterion Met?
July 26-29, July 31-August 2, August 7-10, 2018	"Narrative Conceptual Model – July 26-August 10, 2018": pp. 27-40 "Natural Event/Human Activity Unlikely to Recur": p. 145	Sufficient	Yes

Schedule and Procedural Requirements

In addition to technical demonstration requirements, 40 CFR §50.14(c) and 40 CFR §51.930 specify schedule and procedural requirements an air agency must follow to request data exclusion. Table 6 outlines the EPA's evaluation of these requirements.

[33] See demonstration, pp. 27-40.
[34] See demonstration, p. 145.

Table 6: Schedules and Procedural Criteria

	Reference	Demonstration Citation	Criterion Met?
Did the agency provide prompt public notification of the event?	40 CFR §50.14 (c)(1)(i)	"Narrative Conceptual Model – July 26-August 10, 2018": pp. 79-80. Appendix II: pp. 211-214.	Yes
Did the agency submit an Initial Notification of Potential Exceptional Event and flag the affected data in the EPA's Air Quality System (AQS)?	40 CFR §50.14 (c)(2)(i)	Appendix I: pp. 164-165.	Yes
Did the initial notification and demonstration submittals meet the deadlines for data influenced by exceptional events for use in initial area designations, if applicable? Or the deadlines established by the EPA during the Initial Notification of Potential Exceptional Events process, if applicable?	40 CFR §50.14 Table 2 40 CFR §50.14 (c)(2)(i)(B)	Letter from Michael Benjamin, CARB, to Elizabeth Adams, EPA, R9, dated April 21, 2021.	Yes
Was the public comment process followed and documented? • Did the agency document that the comment period was open for a minimum of 30 days? • Did the agency submit to the EPA any public comments received? • Did the state address comments disputing or contradicting factual evidence provided in the demonstration?	40 CFR §50.14 (c)(3)(v)	Letter from Michael Benjamin, CARB, to Elizabeth Adams, EPA R9, dated October 28, 2021.	Yes
Has the agency met requirements regarding submission of a mitigation plan, if applicable?	40 CFR §51.930 (b)	N/A	N/A

Conclusion

The EPA has reviewed the documentation provided by CARB to support claims that smoke from wildfires in Northern and Central California and Southern Oregon, namely the Ranch, River, Carr, Donnell, and Ferguson fires, caused exceedances of the 2008 8-hour O_3 NAAQS at the Grass Valley monitoring site on July 26-29, 2018, July 31-August 2, 2018, and August 7-10, 2018. The EPA has determined that the flagged exceedances at this monitoring site on these days satisfy the exceptional event criteria: the event was a natural event, which affected air quality in such a way that there exists a clear causal relationship between the event and the monitored exceedances and was not reasonably controllable or preventable. The EPA has also determined that CARB has satisfied the schedule and procedural requirements for data exclusion.

ENCLOSURE: TECHNICAL SUPPORT DOCUMENT FOR EPA CONCURRENCE ON O_3 EXCEEDANCES MEASURED IN THE WESTERN PART OF NEVADA COUNTY (GRASS VALLEY, CALIFORNIA) ON AUGUST 20-21, 2020 AS AN EXCEPTIONAL EVENT

On November 19, 2021, the California Air Resources Board (CARB) submitted an exceptional event demonstration for exceedances of the 2008 8-hour ozone (O_3) National Ambient Air Quality Standards (NAAQS) of 0.075 parts per million (ppm) that occurred at Grass Valley-Litton Building monitoring site on August 20-21, 2020.[1] The demonstration submitted by CARB stated that the exceedances measured on August 20-21, 2020 were caused by multiple wildfires burning across Northern and Central California including the August, LNU, SCU, CZU and North complexes and the Jones, Salt and MOC fires.[2] Under the Exceptional Events Rule, air agencies can request the exclusion of event-influenced data, and the EPA can agree to exclude these data, from the data set used for certain regulatory decisions. The remainder of this document summarizes the Exceptional Events Rule requirements, the event and the EPA's review process.

EXCEPTIONAL EVENTS RULE REQUIREMENTS

The EPA promulgated the Exceptional Events Rule in 2007, pursuant to the 2005 amendment of Clean Air Act (CAA) Section 319. In 2016, the EPA finalized revisions to the Exceptional Events Rule. The 2007 Exceptional Events Rule and 2016 Exceptional Events Rule revisions added sections 40 CFR §50.1(j)-(r); §50.14; and §51.930 to title 40 of the Code of Federal Regulations (CFR). These sections contain definitions, criteria for EPA approval, procedural requirements, and requirements for air agency demonstrations. The EPA reviews the information and analyses in the air agency's demonstration package using a weight of evidence approach and decides to concur or not concur. The demonstration must satisfy all of the Exceptional Events Rule criteria for the EPA to concur with excluding the air quality data from regulatory decisions.

Under 40 CFR §50.14(c)(3)(iv), the air agency demonstration to justify exclusion of data must include:

A. "A narrative conceptual model that describes the event(s) causing the exceedance or violation and a discussion of how emissions from the event(s) led to the exceedance or violation at the affected monitor(s);"

B. "A demonstration that the event affected air quality in such a way that there exists a clear causal relationship between the specific event and the monitored exceedance or violation;"

C. "Analyses comparing the claimed event-influenced concentration(s) to concentrations at the same monitoring site at other times" to support requirement (B) above;

[1] "Exceptional Events Demonstration for Ozone Exceedances Northern California 2020 Wildfire Events," (November 18, 2021) ("demonstration"). The demonstration also includes exceptional events analyses for other California nonattainment areas for the 2008 and/or 2015 NAAQS. The EPA's evaluation of the information presented in the demonstration is reflected in four separate technical support documents.

[2] See demonstration, p. 64.

D. "A demonstration that the event was both not reasonably controllable and not reasonably preventable;" and

E. "A demonstration that the event was a human activity that is unlikely to recur at a particular location or was a natural event."[3]

In addition, the air agency must meet several procedural requirements, including:

1. submission of an Initial Notification of Potential Exceptional Event and flagging of the affected data in the EPA's Air Quality System (AQS) as described in 40 CFR §50.14(c)(2)(i),

2. completion and documentation of the public comment process described in 40 CFR §50.14(c)(3)(v), and

3. implementation of any relevant mitigation requirements as described in 40 CFR §51.930.

For data influenced by exceptional events to be excluded from use in initial area designations, air agencies must also meet the initial notification and demonstration submission deadlines specified in Table 2 to 40 CFR §50.14. We include below a summary of the Exceptional Events Rule criteria, including those identified in 40 CFR §50.14(c)(3)(iv).

Regulatory Significance

The 2016 Exceptional Events Rule includes regulatory language that applies the provisions of CAA section 319 to a specific set of regulatory actions. As identified in 40 CFR §50.14(a)(1)(i), these regulatory actions include initial area designations and redesignations; area classifications; attainment determinations (including clean data determinations); attainment date extensions; findings of State Implementation Plan (SIP) inadequacy leading to a SIP call; and other actions on a case-by-case basis as determined by the Administrator. Air agencies and the EPA should discuss the regulatory significance of an exceptional events demonstration during the Initial Notification of Potential Exceptional Event prior to the air agency submitting a demonstration for the EPA's review.

Narrative Conceptual Model

The 2016 Exceptional Events Rule directs air agencies to submit, as part of the demonstration, a narrative conceptual model of the event that describes and summarizes the event in question and provides context for analyzing the required statutory and regulatory technical criteria. Air agencies may support the narrative conceptual model with summary tables or maps. For wildfire O_3 events, the EPA recommends that the narrative conceptual model also discuss the interaction of emissions, meteorology, and chemistry of event and non-event O_3 formation in the area, and,

[3] A natural event is further described in 40 CFR 50.1(k) as "an event and its resulting emissions, which may recur at the same location, in which human activity plays little or no direct causal role. For purposes of the definition of a natural event, anthropogenic sources that are reasonably controlled shall be considered to not play a direct role in causing emissions."

under 40 CFR §50.14(a)(1)(i), must describe the regulatory significance of the proposed data exclusion.

Clear Causal Relationship and Supporting Analyses

The EPA considers a variety of evidence when evaluating whether there is a clear causal relationship between a specific event and the monitored exceedance or violation. For wildfire O_3 events, air agencies should compare the O_3 data requested for exclusion with seasonal and annual historical concentrations at the air quality monitor to establish a clear causal relationship between the event and monitored data. In addition to providing this information on the historical context for the event-influenced data, air agencies should further support the clear causal relationship criterion by demonstrating that the wildfire's emissions were transported to the monitor, that the emissions from the wildfire influenced the monitored concentrations, and, in some cases, air agencies may need to provide evidence of the contribution of the wildfire's emissions to the monitored O_3 exceedance or violation.

For wildfire O_3 events, the EPA has published a guidance document that provides three different tiers of analyses that apply to the "clear causal relationship" criterion within an air agency's exceptional events demonstration.[4] This tiered approach recognizes that some wildfire events may be more clear and/or extreme and, therefore, require relatively less evidence to satisfy the rule requirements. If a wildfire/O_3 event satisfies the key factors for either Tier 1 or Tier 2 clear causal analyses, then those analyses are the only analyses required to support the clear causal relationship criterion within an air agency's demonstration for that particular event. Other wildfire/O_3 events will be considered based on Tier 3 analyses.

- Tier 1: Wildfires that clearly influence monitored O_3 exceedances or violations when they occur in an area that typically experiences lower O_3 concentrations.
    - *Key Factor*: seasonality and/or distinctive level of the monitored O_3 concentration. The event-related exceedance occurs during a time of year that typically has no exceedances, or is clearly distinguishable (*e.g.*, 5-10 parts per billion (ppb) higher) from non-event exceedances.
    - In these situations, O_3 impacts should be accompanied by clear evidence that the wildfire's emissions were transported to the location of the monitor.

- Tier 2: The wildfire event's O_3 influences are higher than non-event related concentrations, and fire emissions compared to the fire's distance from the affected monitor indicate a clear causal relationship.
    - *Key Factor 1*: fire emissions and distance of fire(s) to affected monitoring site location(s). Calculated fire emissions of nitrogen oxides (NO_x) and reactive-volatile organic compounds (VOC) in tons per day (Q) divided by the distance from the fire to the monitoring site (D) should be equal to or greater than 100 tons per day/kilometers ($Q/D \geq 100$ tpd/km). The guidance document provides additional information on the calculation of Q/D.

[4] "Guidance on the Preparation of Exceptional Events Demonstrations for Wildfire Events that May Influence Ozone Concentrations" (September 2016) ("wildfire O_3 guidance document").

- *Key Factor 2*: comparison of the event-related O_3 concentration with non-event related high O_3 concentrations. The exceedance due to the exceptional event:
  - is in the 99th or higher percentile of the 5-year distribution of O_3 monitoring data, OR
  - is one of the four highest O_3 concentrations within 1 year (among those concentrations that have not already been excluded under the Exceptional Events Rule, if any).
- In addition to the analysis required for Tier 1, the air agency should supply additional evidence to support the weight of evidence that emissions from the wildfire affected the monitored O_3 concentration.

- Tier 3: The wildfire does not fall into the specific scenarios (i.e. does not meet the key factors) that qualify for Tier 1 or Tier 2, but the clear causal relationship criterion can still be satisfied by a weight of evidence showing.
  - In addition to the analyses required for Tier 1 and Tier 2, an air agency may further support the clear causal relationship with additional evidence that the fire emissions caused the O_3 exceedance.

Not Reasonably Controllable or Preventable

The Exceptional Events Rule requires that air agencies establish that the event be both not reasonably controllable and not reasonably preventable at the time the event occurred. This requirement applies to both natural events and events caused by human activities; however, it is presumed that wildfires on wildland will satisfy both factors of the "not reasonably controllable or preventable" element unless evidence in the record clearly demonstrates otherwise.[5]

Natural Event

According to the CAA and the Exceptional Events Rule, an exceptional event must be "an event caused by human activity that is unlikely to recur at a particular location *or* a natural event" (emphasis added). The 2016 Exceptional Events Rule includes in the definition of wildfire that "[a] wildfire that predominantly occurs on wildland is a natural event." Once an agency provides evidence that a wildfire on wildland occurred and demonstrates that there is a clear causal relationship between the measurement under consideration and the event, the EPA expects minimal documentation to satisfy the "human activity that is unlikely to recur at a particular location or a natural event" element. The EPA will address wildfires on other lands on a case-by-case basis.

EPA REVIEW OF EXCEPTIONAL EVENTS DEMONSTRATION

On March 15, 2021, CARB submitted an Initial Notification of a potential Exceptional Event for seven exceedances of the 2008 8-hour O_3 NAAQS that occurred at Grass Valley-Litton Building

[5] A wildfire is defined in 40 CFR 50.1(n) as "any fire started by an unplanned ignition caused by lightning; volcanoes; other acts of nature; unauthorized activity; or accidental, human-caused actions, or a prescribed fire that has developed into a wildfire. A wildfire that predominantly occurs on wildland is a natural event." Wildland is defined in 40 CFR 50.1(o) as "an area in which human activity and development are essentially non-existent, except for roads, railroads, power lines, and similar transportation facilities. Structures, if any, are widely scattered."

monitoring site within Nevada County, California (CA) between August 20 to August 29, 2020.[6] On November 19, 2021, CARB submitted an exceptional event demonstration for two exceedances of the 2008 8-hour O_3 NAAQS that occurred at the Grass Valley-Litton Building monitoring site within Nevada County, CA on August 20-21, 2020.[7]

Regulatory Significance

The EPA determined that data exclusion of certain exceedances referenced in the Initial Notification may have a regulatory significance for a determination of attainment by the attainment date for the Nevada County (Western part), CA Serious nonattainment area for the 2008 O_3 NAAQS and worked with CARB to identify the relevant exceedances and monitoring sites affected.[8] Table 1 summarizes the exceedances measured at the Grass Valley-Litton Building monitoring site in August 2020 that CARB included in the demonstration.

Table 1: 2008 8-hour O_3 NAAQS Exceedance Summary

Exceedance Date	Monitoring Site Name	AQS ID	2008 8-hour Avg. (ppm)
August 20, 2020	Grass Valley-Litton Building	06-057-0005	0.122
August 21, 2020	Grass Valley-Litton Building	06-057-0005	0.104

Narrative Conceptual Model

The demonstration submitted by CARB provided a narrative conceptual model in the "Overview/Introduction," "Background," and "Narrative Conceptual Model" sections of the demonstration to describe how emissions from wildfires in Northern and Central California including the August, LNU, SCU, CZU and North complexes and the Jones, Salt and MOC fires caused the O_3 exceedances at Grass Valley-Litton Building monitoring site. The demonstration stated that these exceptional event days are significant for determining if the Nevada County (Western Part) Serious nonattainment area is attaining the 2008 8-hour average O_3 NAAQS.[9]

The "Overview/Introduction" and "Background" chapters provided information supporting the narrative conceptual model including characteristics of the nonattainment area, such as geography, topography, meteorology, the ambient O_3 monitoring network, typical non-event O_3 formation conditions and patterns, seasonal O_3 variations, and emissions of O_3 precursors.[10]

The narrative conceptual model described characteristics of the event. This included a summary of the occurrences of wildfires in Northern and Central California and specific descriptions of wildfires, including the August, LNU, SCU, CZU, and North complexes and individual wildfires such as the Jones, Salt, and MOC fires that generated smoke contributing to O_3 exceedances at the Grass Valley-Litton Building monitoring site from August 20-21, 2020.[11] The demonstration provided tables for the actively burning fires during the time of the exceedances which include

[6] See email from Sylvia Vanderspek, CARB, to Gwen Yoshimura, EPA Region 9, dated March 15, 2021.
[7] See letter from Michael Benjamin, CARB, to Matthew Lakin, EPA Region 9, dated November 18, 2021.
[8] See letter from Elizabeth Adams, EPA Region 9, to Sylvia Vanderspek, CARB, dated April 21, 2021.
[9] See demonstration p. 2.
[10] See demonstration pp. 11-15, 18-19, 20, 83, 106.
[11] See demonstration, pp. 20-22, 64.

the fire name, cause, start date, containment date, location, and total acreage burned along with maps of the fire perimeters.[12] The narrative conceptual model also included figures displaying meteorological conditions on the dates of the fires and Hybrid Single Particle Lagrangian Integrated Trajectory (HYSPLIT) modeling results. The HYSPLIT trajectory modeling results were presented with satellite imagery, Hazard and Mapping System (HMS) satellite-derived smoke layers, and meteorological analysis to support that wildfire emissions were transported to the Grass Valley-Litton Building monitoring site on the exceptional event dates requested for exclusion. Along with these graphics, the narrative conceptual model included descriptions of how dense wildfire smoke from numerous lightning-caused wildfires, including those that combined to form the August, LNU, SCU, CZU and North complex fires, spread across the Sacramento Valley and portions of the Sierra Nevada, including Grass Valley, on August 20-21, 2020.[13]

The narrative conceptual model presented charts showing event related concentrations and long-term trends. This included a plot of the 1-hour O_3 and particulate matter less than or equal to 2.5 microns in aerodynamic diameter ($PM_{2.5}$) concentrations measured at the Grass Valley-Litton Building monitoring site from August 17 through August 26, 2020 (Figure III-33). Simultaneous increases in O_3 and $PM_{2.5}$ followed by sustained elevated concentrations on August 20 through August 21, 2020 support the presence of wildfire smoke on the days requested as exceptional events. The demonstration also included a chart of 8-hour O_3 design values at the Grass Valley-Litton Building monitoring site from 2009-2020 shown in Figure III-34. Figure III-35 presents the annual 4th high 8-hour average O_3 values from 2009-2020. Both figures include a trendline, and the design and annual 4th high O_3 values for 2018, 2019, and 2020 with and without the exceptional event days to suggest that recent years may have been influenced by wildfires.[14]

The narrative conceptual model also included meteorological data such as the maximum daily temperatures and wind speeds along with 1-hour and 8-hour O_3 concentrations from the Grass Valley-Litton Building monitoring site. This information was presented to show that weather patterns observed on exceptional event days were not generally more favorable for O_3 formation than on non-event days.[15] Tables III-20 and III-21 show that the average wind speed and temperatures during the exceptional event days were within one standard deviation of the average wind speed and temperatures on non-event days in August. Table III-24 shows the maximum daily O_3, temperature, and wind speeds at the Grass Valley-Litton Building monitoring site from August 17 through August 26, 2020. The demonstration noted that the days preceding the exceptional event days recorded slightly higher temperatures and similar wind speeds but significantly lower O_3 concentrations than the event days. The demonstration concluded that O_3 directly related to wildfire smoke influenced the exceedances as opposed to unusual weather.[16]

The narrative conceptual model included descriptions of air quality advisories issued by Nevada County, Northern Sierra Air Quality Management District and the Nevada County Public Health Department, and also included National Weather Service (NWS) Area Forecast Discussions of

[12] See demonstration, pp. 22-60.
[13] See demonstration, pp. 64-65.
[14] See demonstration, pp. 78-82.
[15] See demonstration, pp. 85-86.
[16] See demonstration, pp. 83-86.

smoke, and examples of social media coverage of the 2020 wildfires in Northern and Central California.[17]

Overall, the demonstration contained the elements required for inclusion in the conceptual model portion of the exceptional events demonstration.

Table 2: Documentation of the Narrative Conceptual Model

Exceedance Date	Demonstration Citation	Quality of Evidence	Criterion Met?
August 20-21, 2020	"Overview/Introduction": p. 2 "Background": pp. 11-15, 18-19 "Narrative Conceptual Model": pp. 20-60, 64-65, 78-83, 85-86 "Clear Causal Relationship": p. 106 Appendix B: pp. 135-137 Appendix C: pp. 143-149 Appendix E: pp. 218, 223-226, 227-228	Sufficient	Yes

Clear Causal Relationship

The demonstration included several analyses to support a clear causal relationship between the wildfire event and the monitored exceedances. These analyses were presented in the "Clear Causal Relationship" section of the demonstration.

Comparison with historical concentrations

The demonstration included a comparison with historical concentrations, as required by 40 CFR §50.14(c)(3)(iv)(C). The demonstration compared O_3 concentrations at the Grass Valley-Litton Building monitoring site on the 2020 wildfire exceptional event days to historical non-event O_3 concentrations from 2015-2020. This included a graph of daily maximum 8-hour average concentrations over the six-year period by day of the year, along with the level of the NAAQS and the 99th percentile value at the site. Figure IV-3 shows this graph with the August 20 and 21 measurements falling well above the 99th percentile values and higher than all other measurements in the 2015-2020 period.[18]

Tier 1: Key Factor

To meet the key factor for a Tier 1 analysis, exceedances should be clearly higher than other non-event related exceedances, or occur during a time of year that typically experiences no exceedances. The exceedances identified in this demonstration are within the high O_3 season, but they are in the 99th percentile of 8-hour concentration values and at least 0.005 ppm higher than other O_3 exceedances in the prior five years when the 2018 exceptional events are excluded.[19] Therefore, the August 20-21, 2020 exceedances meet the Tier 1 Key Factor. The EPA's wildfire O_3 guidance document indicates that a Tier 1 analysis may be appropriate for this event. However, the demonstration included the required elements for a Tier 1 clear causal relationship analysis as well as those required for a more stringent Tier 2 clear causal relationship analysis.

Tier 2: Key Factors

[17] See demonstration, Appendix B, pp. 135-137, Appendix C, pp. 143-149, Appendix E, pp. 218, 223-228.
[18] See demonstration, p. 91.
[19] See demonstration pp. 89-91.

The demonstration included an evaluation of the Tier 2 Key Factors. For Tier 2 Key Factor 1, the demonstration provided an analysis of fire emissions (Q) and distance (D) of the wildfires to the monitoring site locations. The Q/D value is generally calculated by dividing wildfire emissions (in tpd) by the distance between the wildfire and the monitoring site (in kilometers [km]). Daily Q/D values were calculated by the EPA using daily wildland fire emissions input files originally created for the Community Multiscale Air Quality (CMAQ) modeling system. The resulting calculations were shared with CARB to assist in demonstration development. CMAQ input files included daily total emissions of nitrogen oxide, nitrogen dioxide, and reactive organic gases at release points corresponding to wildfire locations. Q/D was calculated for each CMAQ input release point by calculating the distance between release point locations and gridded receptor locations and dividing the associated fire's daily total emissions by this distance. An aggregated daily Q/D was then calculated by summing the individual Q/D values for each release point. An "effective Q/D" value was calculated at monitoring site receptor locations by accounting for periods where multiple days of wildfire smoke buildup impacts the monitoring site for up to three total days; the dates to include in each daily "effective Q/D" were based on meteorology and transport analyses, with the rationale outlined in the demonstration.[20] The distance-weighted sums for the requested dates are 186. and 244 tpd/km, which are above the Tier 2 Key Factor 1 screening value of 100 tons per day of NO_x and VOC per km.[21] Therefore, the event exceedances meet Tier 2 Key Factor 1.

For Tier 2 Key Factor 2, the demonstration included evidence that the exceedances are at or above the 99th percentile from the past five years of O_3 season data (2015-2019) or among the four highest concentrations measured at the site in 2020. In the demonstration, CARB determined an "adjusted 4th high" corresponding to the 4th highest non-event exceedance monitored in 2020, excluding exceedances for which CARB submitted an exceptional event demonstration.[22] CARB stated that dates impacted by exceptional events should not count against the tally of the four highest O_3 concentrations measured in 2020 because these exceedances were caused by contributions from wildfire emissions.[23] This rationale is supported given that the purpose of the test is to show that the exceedances are high compared to non-event data. Since the excluded 2020 dates are all included in the demonstration being evaluated for the Nevada County (Western part), CA Serious nonattainment area, each individual date would not count towards the four highest concentrations if concurred on by the EPA.[24] As shown in Table IV-6 of the demonstration, the monitored O_3 concentrations on all dates requested as exceptional events exceed the adjusted 4th high O_3 concentration at the Grass Valley-Litton Building monitoring site in 2020.[25] Therefore, the event exceedances meet Tier 2 Key Factor 2.

Based on the analysis of the Key Factors for Tier 2, the EPA's wildfire O_3 guidance document indicates that a Tier 2 analysis is appropriate for this event. As described below, the demonstration included the required elements for a clear causal relationship analysis based on the EPA's wildfire O_3 guidance document. This includes evidence to support that (1) wildfire

[20] See demonstration, pp. 93-94.
[21] See demonstration, pp. 97-98.
[22] See demonstration, pp. 99-101.
[23] See demonstration, p. 99.
[24] This demonstration also includes analyses for exceptional event dates that occurred at the Grass Valley-Litton Building monitoring site on September 12-14, 2020. These exceptional event dates are evaluated by the EPA in a separate TSD.
[25] See demonstration, pp. 103-104.

emissions were transported from the wildfire to the monitor; and (2) wildfire emissions affected the monitor.

Evidence of transport of wildfire emissions from the wildfire to the monitor

The demonstration presented analyses in the "Narrative Conceptual Model" and Appendix C using backward trajectory and forward trajectory modeling.[26] HYSPLIT modeling was used to determine back trajectories and forward trajectories that estimate the movement of air parcels from wildfire locations (forward trajectories, to see where the air parcels travelled to) or from the monitoring site (backward trajectories, to see where the air parcels that ended up at the monitoring site may have come from).[27] In Figure III-22, HYSPLIT back trajectories showing the likely path of air parcels from the monitoring site at three elevations (100 meters (m), 500m, and 1000m) for 36 hours prior to the time of peak concentrations on August 20, 2020 were overlaid on National Oceanic and Atmospheric Administration (NOAA) HMS Fire and Smoke Product imagery.[28] In Figure III-21, HYSPLIT forward trajectories starting on August 20, 2020 from active fires in Northern and Central California at the same three elevations, showing the most likely center path of air parcels for 36 hours, were overlaid on satellite imagery to provide a visual analysis of whether smoke emitted from the fires may have impacted the Grass Valley-Litton Building monitoring site.[29] Additional backward and forward trajectories were presented in Appendix C of the demonstration.[30] The back trajectories from the Grass Valley-Litton Building monitoring site pass through areas of heavy smoke and near fire locations, and the forward trajectories from the LNU and North complex, Jones, MOC and Salt fires approach the monitoring site.[31] The back trajectory and forward trajectory analyses support that the wildfire emissions were transported to the Grass Valley-Litton Building monitoring site on the days requested for exclusion as exceptional events.

Evidence that the wildfire emissions affected the monitor

The demonstration provided additional evidence that wildfire emissions affected the monitor through the correlation between O_3 and $PM_{2.5}$ concentrations, the unusual O_3 diurnal pattern, media reports, and additional measurements such as ceilometer and black carbon.

The concentrations of O_3 and $PM_{2.5}$ were both elevated from August 20, 2020, through August 21, 2020, at the Grass Valley-Litton Building monitoring site, indicating the presence of wildfire emissions impacting the monitor. In Figure III-33, 1-hour O_3 and $PM_{2.5}$ concentrations are shown from August 17-26, 2020. These data show that on August 20th the $PM_{2.5}$ concentrations rose rapidly to over 150 $\mu g/m^3$ while the O_3 concentrations near-simultaneously rose to over 0.120 ppm. Both species remained elevated through August 21st and the O_3 concentrations were greater than 0.80 ppm for all hours while the $PM_{2.5}$ measurements were greater than 100 $\mu g/m^3$.[32]

The unusual O_3 diurnal patterns for the Grass Valley-Litton Building monitoring site are presented in Figure IV-9 for August 20, 2020, and Figure IV-10 for August 21, 2020. In Figure IV-9 the O_3 values rapidly increase from the average hourly values from early morning till

[26] See demonstration, pp. 66-67, Appendix C, pp. 158-188, 192-193.
[27] See demonstration, p. 63.
[28] See demonstration, p. 67.
[29] See demonstration, p. 66.
[30] See demonstration, Appendix C, pp. 158-188, 192-193.
[31] See demonstration, pp. 169-171, 173-174, 176-178, 181-182, 192.
[32] See demonstration, pp. 78-80.

approximately 11:00 AM, to being equal to or near the 95th percentile for seasonal 1-hour O_3 measurements during 2015-2019 by 12:00 PM, and by 3:00 PM exceeding the 95th percentile by about 0.045 ppm. These values remained high throughout the rest of the day on August 20, 2020. In Figure IV-10 the O_3 measurements at Grass Valley for August 21, 2020 remain high, with a slight downward trend overnight until leveling off around 3:00 AM. These measurements continue to exceed the 95th percentile of seasonal 1-hour O_3 measurements over 2015-2019. This trend is unusual because the typical spike in O_3 occurs during daylight hours and then it reacts, and concentrations decrease overnight. The demonstration notes that data is missing for the August 21 7:00 AM PST hour due to a precision check and from 12:00PM-12:00AM PST due to a power failure at the monitoring site.[33] While the initial increase occurs during daylight hours on August 20, 2020, it is much larger than would be expected during a normal daily diurnal pattern, and concentrations do not decrease overnight as would be expected under normal conditions.[34]

The demonstration also included air quality advisories issued by Nevada County, Northern Sierra Air Quality Management District, and the Nevada County Public Health Department, as well as NWS Area Forecast Discussions of smoke. Social media posts concerning the 2020 wildfires in Northern and Central California with images from Grass Valley showing significant smoke at ground level were also included.[35]

Additional evidence presented in the demonstration that emissions caused the exceedances by reaching the ground and the monitor includes the ceilometer data from Yuba City station in Figure IV-20 and Figure IV-21. These show high density aerosols close to the ground and aloft, with well-mixed wildfire smoke below 1 km from August 20-21, 2020. The demonstration also presented back trajectories from the Grass Valley-Litton Building monitoring site showing transport from Yuba City.[36]

Black carbon (BC) is emitted from fires with moist fuels that burn at lower temperatures where incomplete combustion occurs, and large plumes were observed from CZU Lightning Complex, SCU Lightning Complex, LNU Lightning Complex, August Complex, North Complex, Dolan Fire, and other wildfires using the GEOS-5 forward processing model. These emissions often correlate with other VOC emissions and are presented in the demonstration for August 20, 2020 in Figure IV-18, showing a large amount of wildfire BC in the region near the Grass Valley-Litton Building monitoring site.[37] This supports the presence of wildfire smoke impacting the monitor. Additional biomass burning indicators such as levoglucosan, mannosan, and galactosan were not measured during 2020 because speciated monitors were shut down due to the COVID-19 pandemic.[38]

Conclusion

The analyses included in the demonstration, specifically, comparison to historical concentrations and typical diurnal O_3 and $PM_{2.5}$ concentration profiles, Q/D analyses, BC, ceilometer data, HYSPLIT forward and backward trajectory analyses, satellite imagery and descriptions, wildfire

[33] See demonstration, p. 105.
[34] See demonstration, p. 106.
[35] See demonstration, pp. 135-137, 143-149, 218, 223-228.
[36] See demonstration, pp. 112-114.
[37] See demonstration, pp. 110-112.
[38] See demonstration, pp. 110.

smoke emissions estimates, meteorological conditions, air quality district alerts and advisories, social and news media posts, and NOAA and HMS smoke products, sufficiently demonstrate a clear causal relationship between the emissions generated by August, LNU, SCU, CZU, and North complexes, as well as individual fires such as the Jones Fire, the Salt Fire, and the MOC Fire and the exceedances measured at Grass Valley-Litton Building.

Table 3: Documentation of the Clear Causal Relationship criterion

Exceedance Date	Demonstration Citation	Quality of Evidence	Criterion Met?
August 20-21, 2020	"Narrative Conceptual Model": pp. 63, 66-67, 78-80, 84-86 "Clear Causal Relationship": pp. 90-91, 93-94, 97-101, 103-104, 106, 110-114 Appendix B: pp. 135-137 Appendix C: pp. 143-149, 169-171, 173-174, 176-178, 181-182, 192 Appendix E: pp. 218, 223-228	Sufficient	Yes

Not Reasonably Controllable or Preventable

The Exceptional Events Rule presumes that wildfire events on wildland are not reasonably controllable or preventable [40 CFR §50.14(b)(4)]. The demonstration provided evidence that the wildfire event meets definition of wildfire [40 CFR §50.1(n)]. Specifically, the demonstration included maps and descriptions of the wildfire, along with figures showing wildfire boundaries overlaid upon land ownership and wildland-urban interface layers to demonstrate that the fires occurred on wildland or in the urban/wildland interface.[39] The demonstration described that CARB is not aware of any evidence clearly demonstrating that prevention or control efforts beyond those actually made would have been reasonable.[40] Therefore, the documentation provided sufficiently demonstrates that the event was not reasonably controllable and not reasonably preventable.

Table 4: Documentation of the Not Reasonably Controllable or Preventable criterion

Exceedance Date	Demonstration Citation	Quality of Evidence	Criterion Met?
August 20-21, 2020	"Narrative Conceptual Model": pp. 21-62 "Not reasonably Controllable and/or Not Reasonably Preventable": p. 117	Sufficient	Yes

Natural Event

The definition of "wildfire" at 40 CFR §50.1(n) states, "A wildfire that predominantly occurs on wildland is a natural event." As previously described, the demonstration included documentation that the event meets the definition of a wildfire and occurred predominantly on wildland and has therefore shown that the event was a natural event.

[39] See demonstration, pp. 21-62.
[40] See demonstration, p. 117.

Table 5: Documentation of the Natural Event criterion

Exceedance Date	Demonstration Citation	Quality of Evidence	Criterion Met?
August 20-21, 2020	"Narrative Conceptual Model"*:* pp. 20-78 "Natural Event/Human Activity Unlikely to Recur": p. 117	Sufficient	Yes

Schedule and Procedural Requirements

In addition to technical demonstration requirements, 40 CFR §50.14(c) and 40 CFR §51.930 specify schedule and procedural requirements an air agency must follow to request data exclusion. Table 6 outlines the EPA's evaluation of these requirements.

Table 6: Schedules and Procedural Criteria

	Reference	Demonstration Citation	Criterion Met?
Did the agency provide prompt public notification of the event?	40 CFR §50.14 (c)(1)(i)	"Narrative Conceptual Model": pp. 86-88 "Public Notification": pp. 117-118 Appendix B: pp. 134-137 Appendix E: pp. 218, 223-228	Yes
Did the agency submit an Initial Notification of Potential Exceptional Event and flag the affected data in the EPA's Air Quality System (AQS)?	40 CFR §50.14 (c)(2)(i)	Appendix A: pp. 129-130	Yes
Did the initial notification and demonstration submittals meet the deadlines for data influenced by exceptional events for use in initial area designations, if applicable? Or the deadlines established by the EPA during the Initial Notification of Potential Exceptional Events process, if applicable?	40 CFR §50.14 Table 2 40 CFR §50.14 (c)(2)(i)(B)	See letter from Elizabeth Adams, EPA, to Sylvia Vanderspek, CARB, dated March 21, 2021	Yes
Was the public comment process followed and documented? • Did the agency document that the comment period was open for a minimum of 30 days? • Did the agency submit to the EPA any public comments received? • Did the state address comments disputing or contradicting factual evidence provided in the demonstration?	40 CFR §50.14 (c)(3)(v)	"Public Notification": p. 117-118 See letter from Michael Benjamin, CARB, to Matthew Lakin, EPA R9, dated January 7, 2022	Yes
Has the agency met requirements regarding submission of a mitigation plan, if applicable?	40 CFR §51.930 (b)	NA	NA

Conclusion

The EPA has reviewed the documentation provided by CARB to support claims that smoke from wildfires in Central and Northern California including the August, LNU, SCU, CZU and North complexes and the Jones, Salt and MOC fires, caused exceedances of the 2008 8-hour O_3 NAAQS at the Grass Valley-Litton Building monitoring site on August 20-21, 2020. The EPA has determined that the flagged exceedances at this monitoring site on these days satisfy the exceptional event criteria: the event was a natural event, which affected air quality in such a way that there exists a clear causal relationship between the event and the monitored exceedances, and was not reasonably controllable or preventable. The EPA has also determined that CARB has satisfied the schedule and procedural requirements for data exclusion.

ENCLOSURE: TECHNICAL SUPPORT DOCUMENT FOR EPA CONCURRENCE ON O_3 EXCEEDANCES MEASURED IN THE WESTERN PART OF NEVADA COUNTY (GRASS VALLEY, CALIFORNIA) ON SEPTEMBER 12-14, 2020 AS AN EXCEPTIONAL EVENT

On November 19, 2021, the California Air Resources Board (CARB) submitted an exceptional event demonstration for exceedances of the 2008 8-hour ozone (O_3) National Ambient Air Quality Standards (NAAQS) of 0.075 parts per million (ppm) that occurred at the Grass Valley-Litton Building monitoring site on September 12-14, 2020.[1] The demonstration submitted by CARB stated that the exceedances measured between September 12-14, 2020 were caused by multiple wildfires burning across Northern and Central California including the North Complex, Creek, and SQF Complex.[2] Under the Exceptional Events Rule, air agencies can request the exclusion of event-influenced data, and the EPA can agree to exclude these data, from the data set used for certain regulatory decisions. The remainder of this document summarizes the Exceptional Events Rule requirements, the event and the EPA's review process.

EXCEPTIONAL EVENTS RULE REQUIREMENTS

The EPA promulgated the Exceptional Events Rule in 2007, pursuant to the 2005 amendment of Clean Air Act (CAA) Section 319. In 2016, the EPA finalized revisions to the Exceptional Events Rule. The 2007 Exceptional Events Rule and 2016 Exceptional Events Rule revisions added sections 40 CFR §50.1(j)-(r); §50.14; and §51.930 to title 40 of the Code of Federal Regulations (CFR). These sections contain definitions, criteria for EPA approval, procedural requirements, and requirements for air agency demonstrations. The EPA reviews the information and analyses in the air agency's demonstration package using a weight of evidence approach and decides to concur or not concur. The demonstration must satisfy all of the Exceptional Events Rule criteria for the EPA to concur with excluding the air quality data from regulatory decisions.

Under 40 CFR §50.14(c)(3)(iv), the air agency demonstration to justify exclusion of data must include:

A. "A narrative conceptual model that describes the event(s) causing the exceedance or violation and a discussion of how emissions from the event(s) led to the exceedance or violation at the affected monitor(s);"

B. "A demonstration that the event affected air quality in such a way that there exists a clear causal relationship between the specific event and the monitored exceedance or violation;"

C. "Analyses comparing the claimed event-influenced concentration(s) to concentrations at the same monitoring site at other times" to support requirement (B) above;

[1] "Exceptional Events Demonstration for Ozone Exceedances Northern California 2020 Wildfire Events," (November 18, 2021) ("demonstration")." The demonstration also includes exceptional events analyses for other California nonattainment areas for the 2008 and/or 2015 NAAQS. The EPA's evaluation of the information presented in the demonstration is reflected in four separate technical support documents.

[2] See demonstration, pp. 22, 67-68, 98.

D. "A demonstration that the event was both not reasonably controllable and not reasonably preventable;" and

E. "A demonstration that the event was a human activity that is unlikely to recur at a particular location or was a natural event."[3]

In addition, the air agency must meet several procedural requirements, including:

1. submission of an Initial Notification of Potential Exceptional Event and flagging of the affected data in the EPA's Air Quality System (AQS) as described in 40 CFR §50.14(c)(2)(i),

2. completion and documentation of the public comment process described in 40 CFR §50.14(c)(3)(v), and

3. implementation of any relevant mitigation requirements as described in 40 CFR §51.930.

For data influenced by exceptional events to be excluded from use in initial area designations, air agencies must also meet the initial notification and demonstration submission deadlines specified in Table 2 to 40 CFR §50.14. We include below a summary of the Exceptional Events Rule criteria, including those identified in 40 CFR §50.14(c)(3)(iv).

Regulatory Significance

The 2016 Exceptional Events Rule includes regulatory language that applies the provisions of CAA section 319 to a specific set of regulatory actions. As identified in 40 CFR §50.14(a)(1)(i), these regulatory actions include initial area designations and redesignations; area classifications; attainment determinations (including clean data determinations); attainment date extensions; findings of State Implementation Plan (SIP) inadequacy leading to a SIP call; and other actions on a case-by-case basis as determined by the Administrator. Air agencies and the EPA should discuss the regulatory significance of an exceptional events demonstration during the Initial Notification of Potential Exceptional Event prior to the air agency submitting a demonstration for the EPA's review.

Narrative Conceptual Model

The 2016 Exceptional Events Rule directs air agencies to submit, as part of the demonstration, a narrative conceptual model of the event that describes and summarizes the event in question and provides context for analyzing the required statutory and regulatory technical criteria. Air agencies may support the narrative conceptual model with summary tables or maps. For wildfire O_3 events, the EPA recommends that the narrative conceptual model also discuss the interaction of emissions, meteorology, and chemistry of event and non-event O_3 formation in the area, and,

[3] A natural event is further described in 40 CFR 50.1(k) as "an event and its resulting emissions, which may recur at the same location, in which human activity plays little or no direct causal role. For purposes of the definition of a natural event, anthropogenic sources that are reasonably controlled shall be considered to not play a direct role in causing emissions."

under 40 CFR §50.14(a)(1)(i), must describe the regulatory significance of the proposed data exclusion.

Clear Causal Relationship and Supporting Analyses

The EPA considers a variety of evidence when evaluating whether there is a clear causal relationship between a specific event and the monitored exceedance or violation. For wildfire O_3 events, air agencies should compare the O_3 data requested for exclusion with seasonal and annual historical concentrations at the air quality monitor to establish a clear causal relationship between the event and monitored data. In addition to providing this information on the historical context for the event-influenced data, air agencies should further support the clear causal relationship criterion by demonstrating that the wildfire's emissions were transported to the monitor, that the emissions from the wildfire influenced the monitored concentrations, and, in some cases, air agencies may need to provide evidence of the contribution of the wildfire's emissions to the monitored O_3 exceedance or violation.

For wildfire O_3 events, the EPA has published a guidance document that provides three different tiers of analyses that apply to the "clear causal relationship" criterion within an air agency's exceptional events demonstration.[4] This tiered approach recognizes that some wildfire events may be more clear and/or extreme and, therefore, require relatively less evidence to satisfy the rule requirements. If a wildfire/O_3 event satisfies the key factors for either Tier 1 or Tier 2 clear causal analyses, then those analyses are the only analyses required to support the clear causal relationship criterion within an air agency's demonstration for that particular event. Other wildfire/O_3 events will be considered based on Tier 3 analyses.

- Tier 1: Wildfires that clearly influence monitored O_3 exceedances or violations when they occur in an area that typically experiences lower O_3 concentrations.
    - *Key Factor*: seasonality and/or distinctive level of the monitored O_3 concentration. The event-related exceedance occurs during a time of year that typically has no exceedances, or is clearly distinguishable (*e.g.*, 5-10 parts per billion (ppb) higher) from non-event exceedances.
    - In these situations, O_3 impacts should be accompanied by clear evidence that the wildfire's emissions were transported to the location of the monitor.

- Tier 2: The wildfire event's O_3 influences are higher than non-event related concentrations, and fire emissions compared to the fire's distance from the affected monitor indicate a clear causal relationship.
    - *Key Factor 1*: fire emissions and distance of fire(s) to affected monitoring site location(s). Calculated fire emissions of nitrogen oxides (NO_x) and reactive-volatile organic compounds (VOC) in tons per day (Q) divided by the distance from the fire to the monitoring site (D) should be equal to or greater than 100 tons per day/kilometers ($Q/D \geq 100$ tpd/km). The guidance document provides additional information on the calculation of Q/D.

[4] "Guidance on the Preparation of Exceptional Events Demonstrations for Wildfire Events that May Influence Ozone Concentrations" (September 2016) ("wildfire O_3 guidance document").

- *Key Factor 2*: comparison of the event-related O_3 concentration with non-event related high O_3 concentrations. The exceedance due to the exceptional event:
  - is in the 99th or higher percentile of the 5-year distribution of O_3 monitoring data, OR
  - is one of the four highest O_3 concentrations within 1 year (among those concentrations that have not already been excluded under the Exceptional Events Rule, if any).
- In addition to the analysis required for Tier 1, the air agency should supply additional evidence to support the weight of evidence that emissions from the wildfire affected the monitored O_3 concentration.

- Tier 3: The wildfire does not fall into the specific scenarios (i.e. does not meet the key factors) that qualify for Tier 1 or Tier 2, but the clear causal relationship criterion can still be satisfied by a weight of evidence showing.
  - In addition to the analyses required for Tier 1 and Tier 2, an air agency may further support the clear causal relationship with additional evidence that the fire emissions caused the O_3 exceedance.

Not Reasonably Controllable or Preventable

The Exceptional Events Rule requires that air agencies establish that the event be both not reasonably controllable and not reasonably preventable at the time the event occurred. This requirement applies to both natural events and events caused by human activities; however, it is presumed that wildfires on wildland will satisfy both factors of the "not reasonably controllable or preventable" element unless evidence in the record clearly demonstrates otherwise.[5]

Natural Event

According to the CAA and the Exceptional Events Rule, an exceptional event must be "an event caused by human activity that is unlikely to recur at a particular location *or* a natural event" (emphasis added). The 2016 Exceptional Events Rule includes in the definition of wildfire that "[a] wildfire that predominantly occurs on wildland is a natural event." Once an agency provides evidence that a wildfire on wildland occurred and demonstrates that there is a clear causal relationship between the measurement under consideration and the event, the EPA expects minimal documentation to satisfy the "human activity that is unlikely to recur at a particular location or a natural event" element. The EPA will address wildfires on other lands on a case-by-case basis.

EPA REVIEW OF EXCEPTIONAL EVENTS DEMONSTRATION

On March 15, 2021, CARB submitted an Initial Notification of a potential Exceptional Event for three exceedances of the 2008 8-hour O_3 NAAQS that occurred at Grass Valley-Litton Building

[5] A wildfire is defined in 40 CFR 50.1(n) as "any fire started by an unplanned ignition caused by lightning; volcanoes; other acts of nature; unauthorized activity; or accidental, human-caused actions, or a prescribed fire that has developed into a wildfire. A wildfire that predominantly occurs on wildland is a natural event." Wildland is defined in 40 CFR 50.1(o) as "an area in which human activity and development are essentially non-existent, except for roads, railroads, power lines, and similar transportation facilities. Structures, if any, are widely scattered."

monitoring site within Nevada County, California on September 12-14, 2020.[6] On November 19, 2021, CARB submitted an exceptional event demonstration for three exceedances of the 2008 8-hour O_3 NAAQS that occurred at the Grass Valley-Litton Building monitoring site within Nevada County, California (CA) on September 12-14, 2020.[7]

Regulatory Significance

The EPA determined that data exclusion of some of the exceedances referenced in the Initial Notification may have a regulatory significance for a determination of attainment by the attainment date for the Nevada County (Western part), CA Serious nonattainment area attained for the 2008 NAAQS and worked with CARB to identify the relevant exceedances and monitoring sites affected.[8] Table 1 summarizes the exceedances measured at the Grass Valley-Litton Building monitoring site in September 2020 that CARB included in the demonstration.

Table 1: 2008 8-hour O_3 NAAQS Exceedance Summary

Exceedance Date	Monitoring Site Name	AQS ID	2008 8-hour Avg. (ppm)
September 12, 2020	Grass Valley-Litton Building	06-057-0005	0.086
September 13, 2020	Grass Valley-Litton Building	06-057-0005	0.081
September 14, 2020	Grass Valley-Litton Building	06-057-0005	0.079

Narrative Conceptual Model

The demonstration submitted by CARB provided a narrative conceptual model in the "Overview/Introduction," "Background," and "Narrative Conceptual Model" sections of the demonstration to describe how emissions from numerous wildfires in Northern and Central California including the North Complex, Creek, and SQF Complex caused the O_3 exceedances at Grass Valley-Litton Building monitoring site. The demonstration stated that these exceptional event days are significant for determining if the Nevada County (Western Part) Serious nonattainment area is attaining the 2008 8-hour average O_3 NAAQS.[9]

The "Overview/Introduction" and "Background" chapters provided information supporting the narrative conceptual model including characteristics of the nonattainment area, such as geography, topography, meteorology, the ambient O_3 monitoring network, typical non-event O_3 formation conditions and patterns, seasonal O_3 variations, and emissions of O_3 precursors.[10]

The narrative conceptual model described characteristics of the event. This included a summary of the occurances of wildfires in Northern and Central California and specific descriptions of individual wildfires that generated smoke contributing to O_3 exceedances at the Grass Valley-Litton Building monitoring site from September 12-14, 2020.[11] Many of these wildfires,

[6] See email from Sylvia Vanderspek, CARB, to Gwen Yoshimura, EPA Region 9, dated March 15, 2021.
[7] See letter from Michael Benjamin, CARB, to Matthew Lakin, EPA Region 9, dated November 18, 2021.
[8] See letter from Elizabeth Adams, EPA Region 9, to Sylvia Vanderspek, CARB, dated April 21, 2021.
[9] See demonstration p. 2.
[10] See demonstration pp. 11-15, 18-19, 20, 83.
[11] See demonstration pp. 20-22.

including the North Complex and SQF Complex began due to lightning strikes. The North Complex burned in Plumas, Butte, and Yuba counties, and the SQF Complex burned in Tulare County. The source of the Creek Fire is under investigation and burned within Fresno and Madera counties. The demonstration provided tables for the actively burning fires during the time of the exceedances which include the fire name, cause, start date, containment date, location, and total acreage burned along with maps of the fire perimeters.[12]

The narrative conceptual model also included figures displaying meteorological conditions on the dates of the fires and Hybrid Single Particle Lagrangian Integrated Trajectory (HYSPLIT) modeling results. The HYSPLIT trajectory modeling results were presented with satellite imagery, Hazard and Mapping System (HMS) satellite-derived smoke layers, and meteorological analysis to support that wildfire emissions were transported to the Grass Valley-Litton Building monitoring site on the exceptional event dates requested for exclusion. Along with these graphics, the narrative conceptual model included National Weather Service (NWS) surface weather maps and narrative descriptions of how meteorological conditions affected the behavior of air and smoke in the areas of the wildfires on September 12-14, 2020.[13]

The narrative conceptual model included charts showing event related concentrations and long-term trends. The concentrations of 1-hour O_3 and particulate matter less than or equal to 2.5 microns in aerodynamic diameter ($PM_{2.5}$) were presented in Figure III-33. The demonstration stated that during the event, the timing of elevated $PM_{2.5}$ concentrations show strong connections with O_3 increases and prolonged elevated O_3 concentrations, supportive of a strong influence by wildfire smoke.[14] The demonstration also included a chart of 8-hour O_3 design values from 2009-2020 shown in Figure III-34 at the Grass Valley-Litton Building monitoring site. The figure included a trendline and the 2018, 2019, and 2020 design values with and without the requested exceptional event days; the demonstration suggested that the increasing trend in O_3 design values since 2013 has been heavily impacted by wildfires. Figure III-35 presents the annual 4th high 8-hour average O_3 concentration, which have also had a recent increasing trend over the last decade possibly due to wildfire influence. The demonstration notes 2019 was a relatively quiet year for wildfires and can be seen to break from the increasing trend in design values and annual fourth highs.[15]

The narrative conceptual model also included daily meteorological data such as maximum temperatures and wind speeds along with 1-hour and 8-hour O_3 concentrations from the Grass Valley-Litton Building monitoring site. This information was presented to show that weather patterns observed at the Grass Valley-Litton Building monitoring site on exceptional event days were not generally more favorable for O_3 formation than on non-event days during the September 12-14, 2020 period.[16] Tables III-20 and III-21 show that the average wind speed and temperatures of the exceptional event days were within one standard deviation of the average wind speed and temperatures for non-event days in September. Table III-25 presents the daily maximum 1-hour and 8-hour O_3 concentrations, temperature, and wind speeds for August 9-17, 2020 at the Grass Valley-Litton Building monitoring site. The demonstration noted that the days

[12] See demonstration pp. 22-60.
[13] See demonstration, pp. 67-71.
[14] See demonstration, pp.78, 80.
[15] See demonstration, pp. 78-82.
[16] See demonstration, pp. 85-86.

preceding and following the exceptional event days recorded slightly higher wind speeds and similar temperatures but substantially lower O_3 concentrations compared to the event days.[17] The demonstration concluded that O_3 directly related to wildfire smoke influenced the exceedances as opposed to unusual weather.[18]

The narrative conceptual model included descriptions of air quality advisories issued by Northern Sierra Air Quality Management District (AQMD), National Oceanic and Atmospheric Association (NOAA) Smoke Test Products, NWS Area Forecast Discussions of wildfires and smoke impacts, as well as examples of social media coverage of the 2020 wildfires in Northern and Central California.[19]

Overall, the demonstration contained the elements required for inclusion in the conceptual model portion of the exceptional events demonstration.

Table 2: Documentation of the Narrative Conceptual Model

Exceedance Date	**Demonstration Citation**	**Quality of Evidence**	**Criterion Met?**
September 12-14, 2020	"Overview/Introduction" pp. 1-7 "Background: pp. 7, 11-15, 18-20 "Narrative Conceptual Model" pp. 20-60, 67-68, 78-86 "Clear Causal Relationship": pp. 98, 116 Appendix B: p. 137 Appendix C: pp. 151-158 Appendix D: pp. 196-198 Appendix E: pp. 227-228	Sufficient	Yes

Clear Causal Relationship

The demonstration included several analyses to support a clear causal relationship between the wildfire event and the monitored exceedances. These analyses were presented in the "Clear Causal Relationship" section of the demonstration.

Comparison with historical concentrations

The demonstration included a comparison with historical concentrations, as required by 40 CFR §50.14(c)(3)(iv)(C). The demonstration compared O_3 concentrations at the Grass Valley-Litton Building monitoring site on the 2020 wildfire exceptional event days to historical non-event O_3 concentrations from 2015-2020. This included a graph of daily maximum 8-hour average concentrations over the six-year period by day of the year, along with the level of the NAAQS and the 99th percentile value at the site. Figure IV-3 shows that the exceedances occurred during the time of year where O_3 concentrations tend to be higher at the Grass Valley-Litton Building monitoring site. The September 12-14, 2020 exceedance days are below the 99th percentile of 8-hour concentration values and are not clearly distinguishable from non-event exceedances (i.e.,

[17] See demonstration, pp. 83, 85.
[18] See demonstration, pp. 84-86.
[19] See demonstration, pp. 86, 116, 137, 151-158, 196-198, 216-218, 227-228.

they are not at least 0.005 ppm higher than other O_3 exceedances in the prior five years), including when 2018 exceptional events are excluded.[20]

Tier 1: Key Factor

To meet the key factor for a Tier 1 analysis, exceedances should be clearly higher than other non-event related exceedances or occur during a time of year that typically experiences no exceedances. The exceedances identified in this demonstration for September 12-14, 2020, occurred during the high O_3 season and are not in the 99th percentile of 8-hour concentration values and not at least 0.005 ppm higher than other O_3 exceedances in the prior five years; this remains true when 2018 exceptional events are excluded.[21] Therefore, the exceedances do not meet the Tier 1 Key Factor.

Tier 2: Key Factors

The demonstration included an evaluation of the Tier 2 Key Factors. For Tier 2 Key Factor 1, the demonstration provided an analysis of fire emissions (Q) and distance (D) of the wildfires to the monitoring site locations. The Q/D value is generally calculated by dividing wildfire emissions (in tpd) by the distance between the wildfire and the monitoring site (in kilometers [km]). Daily Q/D values were calculated by the EPA using daily wildland fire emissions input files originally created for the Community Multiscale Air Quality (CMAQ) modeling system. The resulting calculations were shared with CARB to assist in demonstration development. CMAQ input files included daily total emissions of nitrogen oxide, nitrogen dioxide, and reactive organic gases at release points corresponding to wildfire locations. Q/D was calculated for each CMAQ input release point by calculating the distance between release point locations and gridded receptor locations and dividing the associated fire's daily total emissions by this distance. An aggregated daily Q/D was then calculated by summing the individual Q/D values for each release point. An "effective Q/D" value was then calculated at monitoring site receptor locations by accounting for periods where multiple days of wildfire smoke buildup impacted the monitoring site for up to three total days; the dates to include in each daily "effective Q/D" were based on meteorology and transport analyses, with the rationale further outlined in the demonstration.[22] The distance-weighted sums for September 12, 13, and 14, 2020 are 378, 362, and 218 tpd/km respectively, which are above the Tier 2 Key Factor 1 screening value of 100 tons per day of NO_x and VOC per km. Therefore, the event exceedances meet Tier 2 Key Factor 1.

For Tier 2 Key Factor 2, the demonstration included evidence that the exceedances are at or above the 99th percentile from the past five years of O_3 season data (2015-2019) or among the four highest concentrations measured at the site in 2020. In the demonstration, CARB determined an "adjusted 4th high" corresponding to the 4th highest non-event exceedance monitored in 2020, excluding exceedances for which CARB submitted an exceptional event demonstration.[23] CARB stated that dates impacted by exceptional events should not count against the tally of the four highest O_3 concentrations measured in 2020 because these exceedances were caused by contributions from wildfire emissions.[24] This rationale is supported given that the purpose of the test is to show that the exceedances are high compared to non-event

[20] See demonstration, pp. 89, 91.
[21] See demonstration, p. 91.
[22] See demonstration, pp. 93-94, 98.
[23] See demonstration, pp. 99-101.
[24] See demonstration, p. 99.

data. Since the excluded dates are all included in the demonstration being evaluated for the Nevada County (Western part), CA Serious nonattainment area, each individual date would not count towards the four highest concentrations if concurred on by the EPA.[25] As shown in Table IV-6 of the demonstration, the monitored O_3 concentrations on all dates requested as exceptional events exceed the adjusted 4th high O_3 concentration (0.078 ppm) at the Grass Valley-Litton Building monitoring site in 2020.[26] Therefore, the event exceedances meet Tier 2 Key Factor 2.

Based on the analysis of the Key Factors for Tier 2, the EPA's wildfire O_3 guidance document indicates that a Tier 2 analysis is appropriate for this event. As described below, the demonstration included the required elements for a clear causal relationship analysis based on the EPA's wildfire O_3 guidance document. This includes evidence to support that (1) wildfire emissions were transported from the wildfire to the monitor; and (2) wildfire emissions affected the monitor.

Evidence of transport of wildfire emissions from the wildfire to the monitor

The demonstration presented analyses in the "Narrative Conceptual Model" and Appendix C using backward trajectory and forward trajectory modeling. HYSPLIT modeling was used to determine back trajectories and forward trajectories that estimate the movement of air parcels from wildfire locations (forward trajectories, to see where the air parcels travelled to) or from the monitoring site (backward trajectories, to see where the air parcels that ended up at the monitoring site may have come from).[27] In Figure III-25, HYSPLIT back trajectories showing the likely path of air parcels from the monitoring site at three elevations (100 meters (m), 500m, and 1000m) for 36 hours prior to the time of peak concentrations on September 12, 2020were overlaid on NOAA HMS Fire and Smoke Product imagery.[28] In Figure III-24, HYSPLIT forward trajectories starting on September 12, 2020 from the North Complex Fire at the same three elevations, showing the most likely center path of air parcels for 36 hours, were overlaid on satellite imagery to provide a visual analysis of whether smoke emitted from the fires may have impacted the Grass Valley-Litton Building monitoring site.[29] Additional backward and forward trajectories were presented in Appendix C of the demonstration.[30] The back trajectories for September 12, 2020 shown in Figure III-25 pass near the fire locations and areas of heavy smoke from the monitoring site. The forward trajectories show the wildfire emissions approach the monitoring site from North Complex, Creek, and SQF Complex fires. The backward and forward trajectory analyses support that the wildfire emissions were transported to the Grass Valley-Litton Building monitoring site on the days requested for exclusion as exceptional events.

Evidence that the wildfire emissions affected the monitor

The demonstration provided additional evidence that wildfire emissions affected the monitor through the correlation between O_3 and $PM_{2.5}$ concentrations, the unusual O_3 diurnal pattern, and media reports.

[25] This demonstration also includes analyses for exceptional event dates that occurred at the Grass Valley monitoring site on August 20-21, 2020. These exceptional event dates are evaluated by the EPA in a separate TSD.
[26] See demonstration, pp. 103-104.
[27] See demonstration, p. 63.
[28] See demonstration, p. 71.
[29] See demonstration, p. 70.
[30] See demonstration, Appendix C, pp. 163-164, 177-178, 185-186, 189, 192-195.

The concentrations of 1-hour O_3 and $PM_{2.5}$ were elevated from September 12-14, 2020, at the Grass Valley-Litton Building monitoring site as shown in Figures III-32 and III-33. During the September event (Figure III-33 bottom), from 1:00 AM on September 12, 2020 through mid-day on September 14, 2020, $PM_{2.5}$ concentrations remained elevated, staying above 100 ug/m^3 for most hours; in the second half of September 14, 2020, concentrations decreased but only to around 50 ug/m^3. Over the entire three-day period, O_3 levels remained above 0.050 ppm, regardless of time of day. The demonstration explained that simultaneous increases in $PM_{2.5}$ and O_3 starting late September 11, 2020 followed by sustained elevated concentrations throughout the event period indicates the presence of wildfire emissions impacting the monitor. [31] The demonstration also provided figures to show elevated $PM_{2.5}$ concentrations across multiple sites in the Mountain Counties Air Basin and Sacramento Valley Air Basin during the time of the exceptional events. This information supports that the wildfire smoke and emissions were widespread across the region and directly impacted monitors at the surface during the period, including the Grass Valley-Litton Building monitoring site.[32]

The unusual O_3 diurnal patterns for the Grass Valley-Litton Building monitoring site are shown in Figures IV-11, IV-12, IV-13, and IV-14 for September 12-14, 2020. For the exceedance day on September 12, the 8-hour exceedance started at 6:00 PM and ended at 1:00 AM on September 13. The last seven hours of this 8-hour period exceeded the 95th percentile values for seasonal 1-hour O_3 measurements during 2015-2019. September 13 was also its own exceedance day, with the 8-hour exceedance starting at 12:00AM and going through 7:00AM (Figure IV-13).[33] All concentrations are above the 95th percentile. Figure IV-14 shows the exceedance on September 14, 2020, which started at 2:00 PM and ended at 9:00 PM; all hours are right around the 95th percentile. The diurnal trend for September 12 and 13, 2020 is particularly unusual; the typical spike in O_3 occurs during daylight hours and then it reacts, and concentrations decrease overnight. The initial increase occurs during the late afternoon on September 12, 2020, and the concentrations do not decrease overnight as would be expected. The diurnal trend on the first two days of the event in particular support the narrative conceptual model.

The demonstration also included air quality advisories issued by Northern Sierra AQMD, NOAA Smoke Test Products, NWS Area Forecast Discussions of wildfires and smoke impacts, as well as examples of social media coverage of the 2020 wildfires in Northern and Central California.[34] Overall, these reports and weather statements support the narrative conceptual model's claim that smoke from the California wildfires reached the ground and impacted the Grass Valley-Litton Building monitoring station during the time of the exceedances.

Conclusion

The analyses included in the demonstration, specifically, comparison to historical concentrations and typical diurnal O_3 and $PM_{2.5}$ concentration profiles, Q/D analyses, HYSPLIT forward and backward trajectory analyses, satellite imagery and descriptions, wildfire smoke emissions estimates, meteorological conditions, air quality district alerts and advisories, social and news media posts, and NOAA HMS smoke products, sufficiently demonstrate a clear causal

[31] See demonstration, pp. 78-80.
[32] See demonstration, pp. 109-110.
[33] See demonstration, pp. 105-108.
[34] See demonstration, pp. 86, 116, 137, 151-158, 196-198, 216-218, 227-228.

relationship between the emissions generated by North Complex, Creek, and SQF Complex fires and the exceedances measured at Grass Valley-Litton Building.

Table 3: Documentation of the Clear Causal Relationship criterion

Exceedance Date	Demonstration Citation	Quality of Evidence	Criterion Met?
September 12-14, 2020	"Narrative Conceptual Model" pp. 63, 70-71, 80, 86 "Clear Causal Relationship": pp. 89-94, 98-110, 116 Appendix B: pp. 137 Appendix C: pp. 151-158, 163-164, 177-178, 185-186 Appendix D: pp. 196-198 Appendix E: pp. 227-228	Sufficient	Yes

Not Reasonably Controllable or Preventable

The Exceptional Events Rule presumes that wildfire events on wildland are not reasonably controllable or preventable [40 CFR §50.14(b)(4)]. The demonstration provided evidence that the wildfire event meets definition of wildfire [40 CFR §50.1(n)]. Specifically, the demonstration included maps and descriptions of the wildfires, along with figures showing wildfire boundaries overlaid upon land ownership and wildland-urban interface layers to demonstrate that the fires occurred on wildland or in the urban/wildland interface.[35] The demonstration described that CARB is not aware of any evidence clearly demonstrating that prevention or control efforts beyond those actually made would have been reasonable.[36] Therefore, the documentation provided sufficiently demonstrates that the event was not reasonably controllable and not reasonably preventable.

Table 4: Documentation of the Not Reasonably Controllable or Preventable criterion

Exceedance Date	Demonstration Citation	Quality of Evidence	Criterion Met?
September 12-14, 2020	"Narrative Conceptual Model": pp. 21-62 "Not reasonably Controllable and/or Not Reasonably Preventable": p. 117	Sufficient	Yes

Natural Event

The definition of "wildfire" at 40 CFR §50.1(n) states, "A wildfire that predominantly occurs on wildland is a natural event." As previously described, the demonstration included documentation that the event meets the definition of a wildfire and occurred predominantly on wildland and has therefore shown that the event was a natural event.

[35] See demonstration, pp. 21-62.
[36] See demonstration, p. 117.

Table 5: Documentation of the Natural Event criterion

Exceedance Date	Demonstration Citation	Quality of Evidence	Criterion Met?
September 12-14, 2020	"Narrative Conceptual Model": pp. 20-78 "Natural Event/Human Activity Unlikely to Recur": p.117	Sufficient	Yes

Schedule and Procedural Requirements

In addition to technical demonstration requirements, 40 CFR §50.14(c) and 40 CFR §51.930 specify schedule and procedural requirements an air agency must follow to request data exclusion. Table 6 outlines the EPA's evaluation of these requirements.

Table 6: Schedules and Procedural Criteria

	Reference	Demonstration Citation	Criterion Met?
Did the agency provide prompt public notification of the event?	40 CFR §50.14 (c)(1)(i)	"Narrative Conceptual Model": pp. 86-88; "Public Notification": pp. 117-118; Appendix B: p. 137; Appendix E: pp. 227-228	Yes
Did the agency submit an Initial Notification of Potential Exceptional Event and flag the affected data in the EPA's Air Quality System (AQS)?	40 CFR §50.14 (c)(2)(i)	Appendix A: pp. 129-130	Yes
Did the initial notification and demonstration submittals meet the deadlines for data influenced by exceptional events for use in initial area designations, if applicable? Or the deadlines established by the EPA during the Initial Notification of Potential Exceptional Events process, if applicable?	40 CFR §50.14 Table 2 40 CFR §50.14 (c)(2)(i)(B)	See letter from Elizabeth Adams, EPA, to Sylvia Vanderspek, CARB, dated March 21, 2021	Yes
Was the public comment process followed and documented? • Did the agency document that the comment period was open for a minimum of 30 days? • Did the agency submit to the EPA any public comments received? • Did the state address comments disputing or contradicting factual evidence provided in the demonstration?	40 CFR §50.14 (c)(3)(v)	"Public Notification": p.117-118, See letter from Michael Benjamin, CARB, to Matthew Lakin, EPA R9, dated January 7, 2022	Yes
Has the agency met requirements regarding submission of a mitigation plan, if applicable?	40 CFR §51.930 (b)	NA	NA

Conclusion

The EPA has reviewed the documentation provided by CARB to support claims that smoke from wildfires in Central and Northern California including the North Complex, Creek, and SQF Complex, caused exceedances of the 2008 8-hour O_3 NAAQS at the Grass Valley-Litton Building monitoring site on September 12-14, 2020. The EPA has determined that the flagged exceedances at this monitoring site on these days satisfy the exceptional event criteria: the event was a natural event, which affected air quality in such a way that there exists a clear causal relationship between the event and the monitored exceedances, and was not reasonably controllable or preventable. The EPA has also determined that CARB has satisfied the schedule and procedural requirements for data exclusion.

ENCLOSURE: TECHNICAL SUPPORT DOCUMENT FOR EPA CONCURRENCE ON O_3 EXCEEDANCE MEASURED IN VENTURA COUNTY, CALIFORNIA ON AUGUST 18, 2020 AS AN EXCEPTIONAL EVENT

On December 8, 2021, the California Air Resources Board (CARB) submitted an exceptional event demonstration for exceedance of the 2008 8-hour ozone (O_3) National Ambient Air Quality Standards (NAAQS) of 0.075 parts per million (ppm) that occurred at the Simi Valley monitoring site on August 18, 2020.[1] The demonstration submitted by CARB stated that the exceedance measured on August 18, 2020 were caused by the Holser and Lake fires burning in Southern California.[2] Under the Exceptional Events Rule, air agencies can request the exclusion of event-influenced data, and the EPA can agree to exclude these data, from the data set used for certain regulatory decisions. The remainder of this document summarizes the Exceptional Events Rule requirements, the event and the EPA's review process.

EXCEPTIONAL EVENTS RULE REQUIREMENTS

The EPA promulgated the Exceptional Events Rule in 2007, pursuant to the 2005 amendment of Clean Air Act (CAA) Section 319. In 2016, the EPA finalized revisions to the Exceptional Events Rule. The 2007 Exceptional Events Rule and 2016 Exceptional Events Rule revisions added sections 40 CFR §50.1(j)-(r); §50.14; and §51.930 to title 40 of the Code of Federal Regulations (CFR). These sections contain definitions, criteria for EPA approval, procedural requirements, and requirements for air agency demonstrations. The EPA reviews the information and analyses in the air agency's demonstration package using a weight of evidence approach and decides to concur or not concur. The demonstration must satisfy all of the Exceptional Events Rule criteria for the EPA to concur with excluding the air quality data from regulatory decisions.

Under 40 CFR §50.14(c)(3)(iv), the air agency demonstration to justify exclusion of data must include:

A. "A narrative conceptual model that describes the event(s) causing the exceedance or violation and a discussion of how emissions from the event(s) led to the exceedance or violation at the affected monitor(s);"

B. "A demonstration that the event affected air quality in such a way that there exists a clear causal relationship between the specific event and the monitored exceedance or violation;"

C. "Analyses comparing the claimed event-influenced concentration(s) to concentrations at the same monitoring site at other times" to support requirement (B) above;

[1] "Exceptional Events Demonstration for Ozone Exceedances Southern California 2020 Wildfire Events," (December 8, 2021) ("demonstration"). The demonstration also includes exceptional events analyses for other California nonattainment areas for the 2008 and/or 2015 NAAQS. The EPA's evaluation of the information presented in the demonstration is reflected in five separate technical support documents.

[2] See demonstration, p. 74.

D. "A demonstration that the event was both not reasonably controllable and not reasonably preventable;" and

E. "A demonstration that the event was a human activity that is unlikely to recur at a particular location or was a natural event."[3]

In addition, the air agency must meet several procedural requirements, including:

1. submission of an Initial Notification of Potential Exceptional Event and flagging of the affected data in the EPA's Air Quality System (AQS) as described in 40 CFR §50.14(c)(2)(i),

2. completion and documentation of the public comment process described in 40 CFR §50.14(c)(3)(v), and

3. implementation of any relevant mitigation requirements as described in 40 CFR §51.930.

For data influenced by exceptional events to be excluded from use in initial area designations, air agencies must also meet the initial notification and demonstration submission deadlines specified in Table 2 to 40 CFR §50.14. We include below a summary of the Exceptional Events Rule criteria, including those identified in 40 CFR §50.14(c)(3)(iv).

Regulatory Significance

The 2016 Exceptional Events Rule includes regulatory language that applies the provisions of CAA section 319 to a specific set of regulatory actions. As identified in 40 CFR §50.14(a)(1)(i), these regulatory actions include initial area designations and redesignations; area classifications; attainment determinations (including clean data determinations); attainment date extensions; findings of State Implementation Plan (SIP) inadequacy leading to a SIP call; and other actions on a case-by-case basis as determined by the Administrator. Air agencies and the EPA should discuss the regulatory significance of an exceptional events demonstration during the Initial Notification of Potential Exceptional Event prior to the air agency submitting a demonstration for the EPA's review.

Narrative Conceptual Model

The 2016 Exceptional Events Rule directs air agencies to submit, as part of the demonstration, a narrative conceptual model of the event that describes and summarizes the event in question and provides context for analyzing the required statutory and regulatory technical criteria. Air agencies may support the narrative conceptual model with summary tables or maps. For wildfire O_3 events, the EPA recommends that the narrative conceptual model also discuss the interaction of emissions, meteorology, and chemistry of event and non-event O_3 formation in the area, and,

[3] A natural event is further described in 40 CFR 50.1(k) as "an event and its resulting emissions, which may recur at the same location, in which human activity plays little or no direct causal role. For purposes of the definition of a natural event, anthropogenic sources that are reasonably controlled shall be considered to not play a direct role in causing emissions."

under 40 CFR §50.14(a)(1)(i), must describe the regulatory significance of the proposed data exclusion.

Clear Causal Relationship and Supporting Analyses

The EPA considers a variety of evidence when evaluating whether there is a clear causal relationship between a specific event and the monitored exceedance or violation. For wildfire O_3 events, air agencies should compare the O_3 data requested for exclusion with seasonal and annual historical concentrations at the air quality monitor to establish a clear causal relationship between the event and monitored data. In addition to providing this information on the historical context for the event-influenced data, air agencies should further support the clear causal relationship criterion by demonstrating that the wildfire's emissions were transported to the monitor, that the emissions from the wildfire influenced the monitored concentrations, and, in some cases, air agencies may need to provide evidence of the contribution of the wildfire's emissions to the monitored O_3 exceedance or violation.

For wildfire O_3 events, the EPA has published a guidance document that provides three different tiers of analyses that apply to the "clear causal relationship" criterion within an air agency's exceptional events demonstration.[4] This tiered approach recognizes that some wildfire events may be more clear and/or extreme and, therefore, require relatively less evidence to satisfy the rule requirements. If a wildfire/O_3 event satisfies the key factors for either Tier 1 or Tier 2 clear causal analyses, then those analyses are the only analyses required to support the clear causal relationship criterion within an air agency's demonstration for that particular event. Other wildfire/O_3 events will be considered based on Tier 3 analyses.

- Tier 1: Wildfires that clearly influence monitored O_3 exceedances or violations when they occur in an area that typically experiences lower O_3 concentrations.
    - *Key Factor*: seasonality and/or distinctive level of the monitored O_3 concentration. The event-related exceedance occurs during a time of year that typically has no exceedances, or is clearly distinguishable (*e.g.*, 5-10 parts per billion (ppb) higher) from non-event exceedances.
    - In these situations, O_3 impacts should be accompanied by clear evidence that the wildfire's emissions were transported to the location of the monitor.

- Tier 2: The wildfire event's O_3 influences are higher than non-event related concentrations, and fire emissions compared to the fire's distance from the affected monitor indicate a clear causal relationship.
    - *Key Factor 1*: fire emissions and distance of fire(s) to affected monitoring site location(s). Calculated fire emissions of nitrogen oxides (NO_x) and reactive-volatile organic compounds (VOC) in tons per day (Q) divided by the distance from the fire to the monitoring site (D) should be equal to or greater than 100 tons per day/kilometers ($Q/D \geq 100$ tpd/km). The guidance document provides additional information on the calculation of Q/D.

[4] "Guidance on the Preparation of Exceptional Events Demonstrations for Wildfire Events that May Influence Ozone Concentrations" (September 2016) ("wildfire O_3 guidance document").

- *Key Factor 2*: comparison of the event-related O_3 concentration with non-event related high O_3 concentrations. The exceedance due to the exceptional event:
  - is in the 99th or higher percentile of the 5-year distribution of O_3 monitoring data, OR
  - is one of the four highest O_3 concentrations within 1 year (among those concentrations that have not already been excluded under the Exceptional Events Rule, if any).
- In addition to the analysis required for Tier 1, the air agency should supply additional evidence to support the weight of evidence that emissions from the wildfire affected the monitored O_3 concentration.

- Tier 3: The wildfire does not fall into the specific scenarios (i.e. does not meet the key factors) that qualify for Tier 1 or Tier 2, but the clear causal relationship criterion can still be satisfied by a weight of evidence showing.
  - In addition to the analyses required for Tier 1 and Tier 2, an air agency may further support the clear causal relationship with additional evidence that the fire emissions caused the O_3 exceedance.

Not Reasonably Controllable or Preventable

The Exceptional Events Rule requires that air agencies establish that the event be both not reasonably controllable and not reasonably preventable at the time the event occurred. This requirement applies to both natural events and events caused by human activities; however, it is presumed that wildfires on wildland will satisfy both factors of the "not reasonably controllable or preventable" element unless evidence in the record clearly demonstrates otherwise.[5]

Natural Event

According to the CAA and the Exceptional Events Rule, an exceptional event must be "an event caused by human activity that is unlikely to recur at a particular location *or* a natural event" (emphasis added). The 2016 Exceptional Events Rule includes in the definition of wildfire that "[a] wildfire that predominantly occurs on wildland is a natural event." Once an agency provides evidence that a wildfire on wildland occurred and demonstrates that there is a clear causal relationship between the measurement under consideration and the event, the EPA expects minimal documentation to satisfy the "human activity that is unlikely to recur at a particular location or a natural event" element. The EPA will address wildfires on other lands on a case-by-case basis.

EPA REVIEW OF EXCEPTIONAL EVENTS DEMONSTRATION

On March 15, 2021, CARB submitted an Initial Notification of a potential Exceptional Event for numerous exceedances of the 2008 8-hour O_3 NAAQS that occurred at the Simi Valley

[5] A wildfire is defined in 40 CFR 50.1(n) as "any fire started by an unplanned ignition caused by lightning; volcanoes; other acts of nature; unauthorized activity; or accidental, human-caused actions, or a prescribed fire that has developed into a wildfire. A wildfire that predominantly occurs on wildland is a natural event." Wildland is defined in 40 CFR 50.1(o) as "an area in which human activity and development are essentially non-existent, except for roads, railroads, power lines, and similar transportation facilities. Structures, if any, are widely scattered."

monitoring site within Ventura County, California (CA) between July 7, 2020 and October 15, 2020.[6] On December 8, 2021, CARB submitted an exceptional event demonstration for one exceedance of the 2008 8-hour O_3 NAAQS that occurred at the Simi Valley monitoring site within Ventura County on August 18, 2020.[7]

Regulatory Significance

The EPA determined that data exclusion of certain exceedances referenced in the Initial Notification may have a regulatory significance for a determination of attainment by the attainment date for the Ventura County, CA Serious nonattainment area for the 2008 O_3 NAAQS and worked with CARB to identify the relevant exceedances and monitoring site affected.[8] Table 1 summarizes the exceedance measured at the Simi Vally monitoring site on August 18, 2020 that CARB included in the demonstration.

Table 1: 2008 8-hour O_3 NAAQS Exceedance Summary

Exceedance Date	Monitoring Site Name	AQS ID	2008 8-hour Avg. (ppm)
August 18, 2020	Simi Valley	06-111-2002	0.086

Narrative Conceptual Model

The demonstration submitted by CARB provided a narrative conceptual model in the "Overview/Introduction," "Background," and "Narrative Conceptual Model" chapters of the demonstration to describe how emissions from the Holser and Lake fires caused the O_3 exceedance at the Simi Valley monitoring site. The demonstration addressed the regulatory significance of the exceptional event in "Overview/Introduction" by stating that the exclusion of data influenced by wildfire events in 2018 and 2020 would affect a determination of attainment for the Ventura County, CA Serious nonattainment area for the 2008 8-hour O_3 NAAQS.[9] The "Overview/Introduction" and "Background" chapters provided information to support the narrative conceptual model including characteristics of the nonattainment area, such as geography, topography, meteorology, the ambient O_3 monitoring network, typical non-event O_3 formation conditions and patterns, seasonal O_3 variations, and emissions of O_3 precursors.[10]

The narrative conceptual model described characteristics of the event. This included a summary of the occurances of wildfires throughout California and specific descriptions of individual wildfires that generated smoke contributing to the O_3 exceedance at the Simi Valley monitoring site on August 18, 2020.[11] The demonstration provided tables for the actively burning fires during the time of the exceedance, including the fire name, source, start date, containment date, location, and total acreage burned along with maps of the fire perimeters.[12] The narrative conceptual model also included figures displaying meteorological conditions on the dates of the fires and Hybrid Single Particle Lagrangian Integrated Trajectory (HYSPLIT) modeling results.

[6] See email from Sylvia Vanderspek, CARB, to Gwen Yoshimura, EPA Region 9, dated March 15, 2021.
[7] See letter from Michael Benjamin, CARB, to Matthew Lakin, EPA Region 9, dated December 8, 2021.
[8] See letter from Elizabeth Adams, EPA Region 9, to Michael Benjamin, CARB, dated April 21, 2021.
[9] See demonstration, pp. 2, 4-6.
[10] See demonstration pp. 10-17, 19-22.
[11] See demonstration pp. 23-26.
[12] See demonstration pp. 25-66.

The HYSPLIT trajectory modeling results were presented with Terra Moderate Resolution Imaging Spectroradiometer (MODIS) satellite imagery and meteorological analysis to support that wildfire emissions were transported to the Simi Valley monitoring site in the South Central Coast Air Basin on the exceptional event date requested for exclusion.[13] Along with these graphics, the narrative conceptual model included wind roses and narrative descriptions of how meteorological conditions affected the behavior of air and smoke in the areas of the wildfires on August 18, 2020.[14] The demonstration specifically stated that dense wildfire smoke from the Holser Fire on August 17, 2020 blew southward between Oxnard and Thousand Oaks, to the west of Simi Valley, and that the following morning, onshore westerly winds brought wildfire smoke and O_3 precursors into the Simi Valley area during the late morning and afternoon hours, as advised by the Ventura County Air Pollution Control District (APCD).[15]

The narrative conceptual model included charts showing event-related concentrations and long-term trends. The demonstration included concentrations of 1-hour O_3 and particulate matter less than or equal to 2.5 microns in aerodynamic diameter ($PM_{2.5}$) from August 15 through August 25, 2020, at the Simi Valley monitoring site, and stated that the elevated $PM_{2.5}$ concentrations demonstrate strong connections with O_3 increases and prolonged elevated O_3 concentrations during the time of the event.[16] The demonstration also included a chart of 8-hour O_3 design values and Annual 4th High O_3 at the Simi Valley monitoring site from 2009 to 2020, suggesting that O_3 concentrations have generally shown a downwards trend during the past twelve years.[17]

The narrative conceptual model also included daily meteorological data such as temperatures and wind speeds along with 1-hr and 8-hr O_3 concentrations from the Simi Valley monitoring site to show that weather patterns observed at the Simi Valley monitoring site on the exceptional event day were not generally more favorable for O_3 formation than on non-event days during the August 15-24, 2020 period.[18] The demonstration specifically compared the August 18 event day to the August 15 non-event day and stated that O_3 concentrations were much higher on August 18 while the maximum temperature was only slightly warmer and both days exhibited similar wind speeds; the slightly higher temperature would be expected to lead to somewhat higher O_3 concentrations, but not as high as was measured. Demonstration Table III-25 shows a maximum daily temperature of 103 degrees Fahrenheit and maximum 8-hr O_3 concentration of 0.50 ppm on August 15; the maximum temperature on August 18 was only one degree higher and the maximum 8-hr O_3 concentration was 0.086 ppm. The demonstration concluded that O_3 directly related to wildfire smoke influenced the exceedance rather than unusual weather.[19] The narrative conceptual model also included descriptions of air quality advisories issued by the Ventura County APCD as well as examples of social media coverage of the 2020 wildfires in Southern, Central, and Northern California.[20]

[13] See demonstration, p. 72, Appendix D.
[14] See demonstration, pp. 71-74, 94, 96-97, Appendix C.
[15] See demonstration, p. 72.
[16] See demonstration, pp. 89-91.
[17] See demonstration, p. 92.
[18] See demonstration pp. 96.
[19] See demonstration pp. 94, 96-97.
[20] See demonstration, pp. 98-101, Appendix F.

Overall, the demonstration contained the elements required for inclusion in the conceptual model criterion of the Exceptional Events Rule.

Table 2: Documentation of the Narrative Conceptual Model

Exceedance Date	Demonstration Citation	Quality of Evidence	Criterion Met?
August 18, 2020	"Overview/Introduction": pp. 1-7 "Background": pp. 10–17, 19-22 "Narrative Conceptual Model": pp. 23-101 Appendix C: pp. 161, 163-165 Appendix D: pp. 188-229, 242-243 Appendix F: pp. 260-263, 274-275	Sufficient	Yes

Clear Causal Relationship

The demonstration included several analyses to support a clear causal relationship between the wildfire event and the monitored exceedance. These analyses were presented in the "Clear Causal Relationship" section of the demonstration.

Comparison with historical concentrations

The demonstration included a comparison with historical concentrations, as required by 40 CFR §50.14(c)(3)(iv)(C). The demonstration compared O_3 concentrations at the Simi Valley monitoring site on the 2020 wildfire exceptional event day to historical non-event O_3 concentrations from 2015-2020. This included a graph of daily maximum 8-hour average concentrations over the six-year period by day of the year, along with the level of the NAAQS and the 99th percentile value at the site. The demonstration noted that the exceptional event occurred during the time of year when O_3 concentrations tend to be higher at this monitoring site and that the exceptional event exceedance at the Simi Valley monitoring site is not clearly distinguishable from non-event exceedances as defined by guidance.[21]

Tier 1: Key Factor

To meet the key factor for a Tier 1 analysis, exceedances should be clearly higher than other non-event related exceedances, or occur during a time of year that typically experiences no exceedances. The exceedance identified in this demonstration occurred within the O_3 season and while high for season, does not exceed non-event exceedance concentrations by at least 5 ppb.[22] Therefore, the exceedance does not meet the Tier 1 Key Factor and additional evidence beyond a Tier 1 analysis is needed to support the clear causal relationship.

Tier 2: Key Factors

The demonstration included an evaluation of the Tier 2 Key Factors. For Tier 2 Key Factor 1, the demonstration provided an analysis of fire emissions (Q) and distance (D) of the wildfires to the monitoring site locations. The Q/D value is generally calculated by dividing wildfire emissions (in tpd) by the distance between the wildfire and the monitoring site (in kilometers [km]). Daily Q/D values were calculated by the EPA using daily wildland fire emissions input files originally created for the Community Multiscale Air Quality (CMAQ) modeling system. The resulting calculations were shared with CARB to assist in demonstration development. CMAQ input files

[21] See demonstration, pp. 102-105.
[22] See demonstration, pp. 103, 105.

included daily total emissions of nitrogen oxide (NO), nitrogen dioxide (NO_2), and reactive organic gases (ROG) at release points corresponding to wildfire locations. Q/D was calculated for each CMAQ input release point by calculating the distance between release point locations and gridded receptor locations and dividing the associated fire's daily total emissions by this distance. An aggregated daily Q/D was then calculated by summing the individual Q/D values for each release point. An "effective Q/D" value was calculated at monitoring site receptor locations by accounting for periods where multiple days of wildfire smoke buildup impacted the monitoring site for up to three total days; the dates to include in each daily "effective Q/D" were based on meteorology and transport analyses, with the rationale further outlined in the demonstration.[23] The distance-weighted sum for the date requested is 32 tpd/km of NO_x and VOC per km, which is below the Tier 2 Key Factor 1 screening value of 100 tpd of NO_x and VOC per km. Therefore, the event exceedance does not meet Tier 2 Key Factor 1.

For Tier 2 Key Factor 2, the demonstration included evidence that the exceedance is at or above the 99th percentile from the past five years of O_3 season data (2015-2019) or among the four highest concentrations measured at the site in 2020. In the demonstration, CARB determined an "adjusted 4th high" corresponding to the 4th highest non-event exceedance monitored in 2020, excluding exceedances for which CARB submitted an exceptional events demonstration.[24] CARB stated that dates impacted by exceptional events should not count against the tally of the four highest O_3 concentrations measured in 2020 because these exceedances were caused by contributions from wildfire emissions.[25] This rationale is supported given that the purpose of the test is to show that the exceedance is high compared to non-event data. Since the excluded dates are all included in the demonstration being evaluated for the Ventura County, CA Serious nonattainment area, each individual date would not count towards the four highest concentrations if concurred on by the EPA. [26] As shown in Table IV-4 of the demonstration, the monitored O_3 concentration on August 18, 2020 requested as an exceptional event is within the 99th percentile for concentrations during the five-year period and exceeds the adjusted 4th high O_3 concentration at the Simi Valley monitoring site in 2020.[27] Therefore, the event exceedance meets Tier 2 Key Factor 2.

Based on the analysis of the Key Factors for Tier 2, the EPA's wildfire O_3 guidance document indicates that a Tier 3 analysis is appropriate for this event. As described below, the demonstration included the required elements for a clear causal relationship analysis based on the EPA's wildfire O_3 guidance document. This includes evidence to support that (1) wildfire emissions were transported from the wildfire to the monitor; (2) wildfire emissions affected the monitor; and (3) wildfire emissions caused the O_3 exceedance.

<u>Tier 3 analysis: Evidence of transport of wildfire emissions from the wildfire to the monitor</u>
The demonstration presented analyses in the "Narrative Conceptual Model" section and Appendix D using backward trajectory and forward trajectory modeling. HYSPLIT back trajectories originating at the monitor location at three elevations (1000 meters (m), 500m, and

[23] See demonstration, pp. 106-107, 109–110.
[24] See demonstration, pp. 111-113.
[25] See demonstration, p. 111.
[26] This demonstration also includes analyses for exceptional event dates that occurred at the Simi Valley monitoring site on August 21, 2020 and September 2-4, 2020. These exceptional event dates are evaluated by the EPA in separate TSDs.
[27] See demonstration, pp. 112-113.

100m) show the likely path of air parcels, 36 hours prior to the first hour of the exceeding 8-hour time period and 36 hours prior to the hour of maximum concentrations within that 8-hour time period on August 18, 2020.[28] HYSPLIT forward trajectories at the same three elevations starting at the Lake (Figure III-22) and Holser wildfire locations show the most likely center path of air parcels for 36 to 48 hours, starting at 4:00 PM PST the day before the exceedance and at 4:00 AM PST the day of the exceedance.[29]

The August 18, 2020 forward trajectory from the Lake Fire initiated at 1200 Coordinated Universal Time (UTC), corresponding to 4:00 AM Pacific Standard Time (PST),[30] indicates that smoke was likely transported to the south and southwest of the fire in the early morning hours of August 18, 2020 before winds transported the smoke to the east.[31] The August 18, 2020 forward trajectory for the Holser Fire initiated at 4:00 AM PST has low spatial resolution, but also seems to indicate that smoke was transported to the south and southwest of the fire during the first few hours of the trajectory before continuing to the north or the south of the fire location and away from the Simi Valley monitoring site.[32] Similarly, back trajectories initiated at 1800 and 2000 UTC (10:00 AM and 12:00 PM PST, respectively) on August 18, 2020 from the Simi Valley monitoring site appear to show transport to the site generally coming from the north, near the fire locations.[33]

As the low spatial resolution of the trajectories presented in the demonstration make it difficult to discern how closely the trajectories pass near the monitoring sites or the fires, the EPA calculated additional HYSPLIT trajectories run in the AirNowTech Navigator.[34] These trajectories are found in Appendix A to this Technical Support Document (TSD). Figures A1 and A2 show 12-hour forward trajectories at 1000m, 500m, and 100m from the Lake and Holser Fires initiated at 3:00 AM and 6:00 AM PST on August 18, 2020, respectively. These trajectories clearly show transport from the fire locations to the Simi Valley monitoring site and surrounding areas within the first half of the trajectories (i.e., approximately 6 hours), after which the trajectories move northward and out of the area. This suggests that smoke from the wildfires impacted the area around the Simi Valley monitoring site in the late morning and early afternoon.

Figures A3 and A4 show 12-hour back trajectories at 1000m, 500m, and 100m from the Simi Valley monitoring site initiated at 10:00 AM and 1:00 PM PST on August 18, 2020, respectively. The trajectories clearly pass over the Lake Fire and near the Holser Fire a few hours prior to reaching the Simi Valley monitoring site. These trajectories provide additional evidence that smoke was transported from these wildfires to the Simi Valley monitoring site in the late morning and early afternoon. Figure A4 in Appendix A of this TSD and the backward trajectories presented in Appendix D of the demonstration also show surface level winds coming

[28] See demonstration, Appendix D, pp. 242-243.
[29] See demonstration, p. 72, Appendix D, pp. 191, 207-208.
[30] HYSPLIT presents results in UTC, which is shown at the top of the HYSPLIT figures included in the demonstration. Times in the demonstration appear to be given in PST and UTC. In August 2020, the local time zone for Ventura County was Pacific Daylight Time (PDT). However, for consistency with the demonstration, this TSD will use PST. The offset from PDT to PST is one hour later (*i.e.*, 12:00 PM in PST is 1:00 PM in PDT).
[31] See demonstration, Appendix D, p. 191.
[32] See demonstration, Appendix D, p. 207-208.
[33] See demonstration, Appendix D, pp. 242-243.
[34] https://www.airnowtech.org/navigator/.

from the southwest to the monitor on August 18, 2020, consistent with the conceptual model presented in the demonstration.[35]

The trajectory analyses are further supported by the MODIS Terra (morning overpass) satellite imagery presented in Figure III-24, showing the Holser and Lake wildfires detected north of Simi Valley, and hazy smoke extending southward to the shoreline; the heaviest smoke appears west of the Simi Valley monitor, consistent with the narrative conceptual model indicating smoke was blown eastward to the monitor in the late morning and afternoon hours.[36] Additionally, the demonstration included Simi Valley hourly wind roses for August 2018, 2019, and 2020 along with August 18, 2020 in Figure III-23 to support that westerly winds are typical in August, and that the hourly winds on August 18, 2020 are consistent with the HYPSLIT trajectory results and narrative conceptual model.[37]

Overall, the backward and forward trajectory analyses, satellite imagery, and wind roses support that the wildfire emissions were transported to the Simi Valley monitoring site on the day requested for exclusion as an exceptional event.

Tier 3 analysis: Evidence that the wildfire emissions affected the monitor

The demonstration provided analyses of O_3, $PM_{2.5}$, and available black carbon (BC) data in subsection B of the "Narrative Conceptual Model" and subsection C of the "Clear Causal Relationship" section as evidence that wildfire emissions impacted the Simi Valley monitoring site on the exceptional event date of August 18, 2020.

Figure IV-9 shows hourly O_3 measurements at the Simi Valley monitoring site compared to historical diurnal percentiles at the site (5^{th}, 50^{th}, and 95^{th} percentiles) from 2015–2019 during O_3 season (April through October).[38] Although the 1-hour O_3 concentrations generally followed a normal diurnal pattern, with peak concentrations occuring around 11:00 AM PST to 3:00 PM PST, the peaks were more dramatic than usual, rapidly rising from 0.015 ppm at 7:00 AM PST up to 0.095 ppm at 12:00 PM PST. O_3 concentrations remained above 0.080 ppm and above the 95^{th} percentile from around 9:00 AM PST to 6:00 PM PST. While the timing of these elevated hourly O_3 values occurred when O_3 typically peaks during the day, the fact that these values were much higher than typical historical values indicate abnormal conditions, such as above-normal temperatures, stable atmospheric conditions, and/or the presence of additional emissions such as wildfire smoke.

The demonstration also included a plot of the 5^{th}, 50^{th}, and 95^{th} percentiles for 1-hour $PM_{2.5}$ during August in 2015-2019 at the Simi Valley monitoring site and compared them with the hourly $PM_{2.5}$ concentrations measured on August 18, 2020 (Figure IV-25).[39] The 5^{th} and 50^{th} percentiles show that $PM_{2.5}$ concentrations are typically stable throughout the day at the Simi Valley site, varying only by about 3-4$\mu g/m^3$. However, the hourly $PM_{2.5}$ concentrations on August 18, 2020 experienced greater fluctuations, with concentrations increasing from around 10-15 $\mu g/m^3$ between 12:00 AM PST and 7:00 AM PST to 24$\mu g/m^3$ at 1:00 PM PST. Moreover,

[35] See demonstration, Appendix D, p. 243.
[36] See demonstration, p. 74.
[37] See demonstration, pp. 72-73.
[38] See demonstration, p. 118.
[39] See demonstration, p. 129.

$PM_{2.5}$ concentrations remained around or above the 95th percentile from approximately 12:00 PM PST through 6:00 PM PST. The higher peak $PM_{2.5}$ concentrations in the afternoon on August 18, 2020 is unusual compared to the seasonal pattern for August for 2015-2019 which typically experienced greater concentrations in the morning. This provides evidence supporting that wildfire smoke and emissions directly impacted the Simi Valley monitoring site on August 18, 2020.

PM and BC measurements (Figure IV-32) at Port Hueneme (approximately 30 miles to the west-southwest of the Simi Valley monitoring site) did not indicate that smoke was present at that site on August 18, 2020.[40] This is corroborated by visible satellite imagery and the HYSPLIT trajectories which did not indicate that smoke from the Lake and Holser Fires were present over the Port Hueneme monitoring site. The demonstration suggested that on August 18, the smoke from the Holser Fire and Lake Fire remained to the east of Port Hueneme, and that any smoke in that area likely remained aloft over a shallow marine layer in Port Hueneme/Oxnard; therefore the lack of elevated $PM_{2.5}$ concentrations or BC signature for this date is consistent with the conceptual model of smoke impacts in the Simi Valley area on August 18, 2020 that did not reach the monitor in Port Hueneme.[41] There are no speciation sites in the South Central Coast Air Basin that reported levoglucosan, mannosan, or galactosan during these events, so no measurements of these compounds were available for analysis for this exceptional event.[42]

The O_3 hourly concentration and percentile profile analysis, $PM_{2.5}$ hourly concentration and percentile profile analysis, and evidence of elevated black carbon measured in the area support that wildfire emissions reached the ground and affected measurements at the Simi Valley monitoring site on August 18, 2020.

Tier 3 analysis: Additional evidence that the wildfire emissions caused the O_3 exceedance
The demonstration included additional evidence to support that the wildfire emissions specifically affected O_3 concentrations at the exceeding Simi Valley monitoring site and caused the O_3 exceedance. The demonstration included an analysis of coincident increases in $PM_{2.5}$ and O_3 on the event day, Navy Aerosol Analysis and Prediction System (NAAPS) modeling, and National Weather Service (NWS) area forecast discussions. These analyses were presented in the "Narrative Conceptual Model" and "Clear Causal Relationship" chapters, and Appendices E and F.

The demonstration provided evidence of a correlation between O_3 and $PM_{2.5}$ concentrations in Figure III-36. The figure shows hourly O_3 and $PM_{2.5}$ concentrations at the Simi Valley monitoring site from August 15-25, 2020. On August 18, it appears that both $PM_{2.5}$ and O_3 increase simultaneously in the morning; the overall concentration of $PM_{2.5}$ is higher than previous days. Daytime hourly concentrations of $PM_{2.5}$ increased from approximately 15 $\mu g/m^3$ on August 17 (with some hourly variation) to 20-25 $\mu g/m^3$ during the day on August 18. The simultaneous increase in $PM_{2.5}$ and O_3 in the morning of August 18, 2020 further suggests that

[40] See demonstration, p. 134.
[41] See demonstration, p. 72.
[42] See demonstration, p. 131.

the increase in O_3 concentrations as compared to historical values was connected to the arrival of wildfire emissions at the monitoring site.[43]

The NAAPS Global Aerosol Model was discussed in the demonstration, and results for August 18, 2020 were presented in Appendix E.[44] The NAAPS Global Aerosol Model provides modeled Total Optical Depth (TOD) and smoke surface concentrations. While the spatial resolution of this model is low, the NAAPS model results for the 5:00 AM and 5:00 PM PST August 18, 2020 runs show enhanced TOD and smoke surface concentrations over large areas of California, including over the Simi Valley monitoring site on August 18, 2020.[45] This further supports the claim that smoke from the Lake and Holser Fires impacted the Simi Valley monitoring site during the time of the exceedance.

The demonstration also provided NWS Area Forecast Discussions, along with media on the events and agency advisories, to support that wildfire emissions affected the Simi Valley monitor on the exceedance day. The NWS Area Forecast Discussions indicate the presence of pyrocumulus plumes from the Lake and Ranch Fires during the afternoon of August 17, 2020 and generally note the presence of smoke widespread across the forecast area in the Forecast Discussions released during the evening on August 18, 2020.[46] The demonstration also included an Air Quality Alert issued by the Ventura County APCD for August 18-19, 2020 that stated that smoke from the Holser Fire would move into the Santa Clara River Valley and surrounding areas with afternoon onshore winds.[47]

Overall, the additional evidence and analyses support that wildfire emissions reached ground level and affected O_3 concentrations at the monitor.

Conclusion

The analyses included in the demonstration, specifically, comparison to historical concentrations, Tier 2 Key Factors including Q/D analyses, HYSPLIT modeling and satellite observations of smoke, correlations between $PM_{2.5}$ and O_3 during the event date, evidence of impacts to hourly O_3 and $PM_{2.5}$ data, and related NWS and Ventura County APCD statements on smoke, sufficiently demonstrate a clear causal relationship between the emissions generated by the Holser and Lake Fires in Southern California and the exceedance measured at the Simi Valley monitoring site.

Table 3: Documentation of the Clear Causal Relationship criterion

Exceedance Date	**Demonstration Citation**	**Quality of Evidence**	**Criterion Met?**
August 18, 2020	"Narrative Conceptual Model": pp. 70-101 "Clear Causal Relationship": pp. 102-107, 110-113, 118, 123, 129-138 Appendix B: p. 156 Appendix C: pp. 159, 163-165 Appendix D: pp. 191-192, 207-208, 242-243 Appendix E: pp. 250-251	Sufficient	Yes

[43] See demonstration, pp. 90-91.
[44] See demonstration, pp. 137-138.
[45] See demonstration, Appendix E, pp. 250-251.
[46] See demonstration, Appendix C, pp. 163-165.
[47] See demonstration, Appendix B, p. 156.

Not Reasonably Controllable or Preventable

The Exceptional Events Rule presumes that wildfire events on wildland are not reasonably controllable or preventable [40 CFR §50.14(b)(4)]. The demonstration provided evidence that the wildfire event meets the definition of wildfire [40 CFR §50.1(n)]. Specifically, the demonstration included maps and descriptions of the wildfires, along with figures showing wildfire boundaries overlaid upon land ownership and wildland-urban interface layers to demonstrate that the fires occurred on wildland or in the urban/wildland interface.[48] The demonstration described that CARB is not aware of any evidence clearly demonstrating that prevention or control efforts beyond those actually made would have been reasonable.[49] Therefore, the documentation provided sufficiently demonstrates that the event was not reasonably controllable and not reasonably preventable.

Table 4: Documentation of the Not Reasonably Controllable or Preventable criterion

Exceedance Date	Demonstration Citation	Quality of Evidence	Criterion Met?
August 18, 2020	"Narrative Conceptual Model"*:* pp. 25, 54-56 "Not reasonably Controllable and/or Not Reasonably Preventable": p. 140	Sufficient	Yes

Natural Event

The definition of "wildfire" at 40 CFR §50.1(n) states, "A wildfire that predominantly occurs on wildland is a natural event." As previously described, the demonstration included documentation that the event meets the definition of a wildfire and occurred predominantly on wildland and has therefore shown that the event was a natural event.

Table 5: Documentation of the Natural Event criterion

Exceedance Date	Demonstration Citation	Quality of Evidence	Criterion Met?
August 18, 2020	"Narrative Conceptual Model"*:* pp. 67-68 "Natural Event/Human Activity Unlikely to Recur": p. 140	Sufficient	Yes

Schedule and Procedural Requirements

In addition to technical demonstration requirements, 40 CFR §50.14(c) and 40 CFR §51.930 specify schedule and procedural requirements an air agency must follow to request data exclusion. Table 6 outlines the EPA's evaluation of these requirements.

[48] See demonstration, pp. 67-68.
[49] See demonstration, p. 140.

Table 6: Schedules and Procedural Criteria

	Reference	Demonstration Citation	Criterion Met?
Did the agency provide prompt public notification of the event?	40 CFR §50.14 (c)(1)(i)	"Narrative Conceptual Model": pp. 70-74 "Public Notification": p. 140; Appendix B: p. 156; Appendix F: p. 262.	Yes
Did the agency submit an Initial Notification of Potential Exceptional Event and flag the affected data in the EPA's Air Quality System (AQS)?	40 CFR §50.14 (c)(2)(i)	Appendix A: pp. 150-153	Yes
Did the initial notification and demonstration submittals meet the deadlines for data influenced by exceptional events for use in initial area designations, if applicable? Or the deadlines established by the EPA during the Initial Notification of Potential Exceptional Events process, if applicable?	40 CFR §50.14 Table 2 40 CFR §50.14 (c)(2)(i)(B)	See letter from Sylvia Vanderspek, CARB, to Elizabeth Adams, EPA, dated March 15, 2021.	Yes
Was the public comment process followed and documented? • Did the agency document that the comment period was open for a minimum of 30 days? • Did the agency submit to the EPA any public comments received? • Did the state address comments disputing or contradicting factual evidence provided in the demonstration?	40 CFR §50.14 (c)(3)(v)	"Public Notification": p. 140; See letter from Michael Benjamin, CARB, to Matthew Lakin, dated December 8, 2021	Yes
Has the agency met requirements regarding submission of a mitigation plan, if applicable?	40 CFR §51.930 (b)	NA	NA

Conclusion

The EPA has reviewed the documentation provided by CARB to support claims that smoke from the Holser and Lake fires in Southern California caused an exceedance of the 2008 8-hour O_3 at the Simi Valley monitoring site on August 18, 2020. The EPA has determined that the flagged exceedance at this monitoring site on this day satisfies the exceptional event criteria: the event was a natural event, which affected air quality in such a way that there exists a clear causal relationship between the event and the monitored exceedance, and was not reasonably controllable or preventable. The EPA has also determined that CARB has satisfied the schedule and procedural requirements for data exclusion.

APPENDIX A: Supplemental figures prepared by the EPA.

Figure A1: HYSPLIT 12-hour forward trajectories from the Lake Fire (top right) and Holser Fire (bottom left) beginning August 18, 2020 at 3:00 AM PST using the NAM 12km domain for height levels of 1000m, 500m, and 100m (using the AirNowTech Navigator). Colored dots indicate monitoring station locations with available hourly O_3 measurements from this time; concentrations (in ppb) measured at the beginning hour are provided as blue numbers. Red triangles indicate active HMS fire detections from August 18, 2020. The Simi Valley monitor is represented by the green colored dot just below the map location name "Simi Valley."

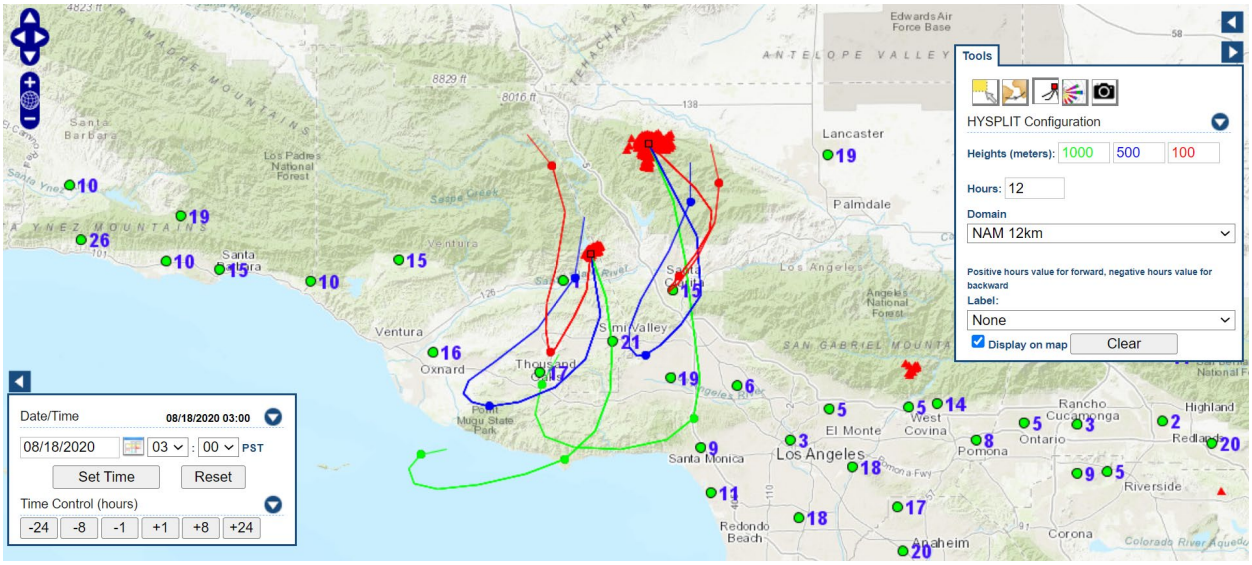


Figure A2: HYSPLIT 12-hour forward trajectories from the Lake Fire (top right) and Holser Fire (bottom left) beginning August 18, 2020 at 6:00 AM PST using the NAM 12km domain for height levels of 1000m, 500m, and 100m (using the AirNowTech Navigator). Colored dots indicate monitoring station locations with available hourly O_3 measurements from this time; concentrations in ppb measured at the beginning hour are provided as blue numbers. Red triangles indicate active HMS fire detections from August 18, 2020. The Simi Valley monitor is represented by the green colored dot just below the map location name "Simi Valley."

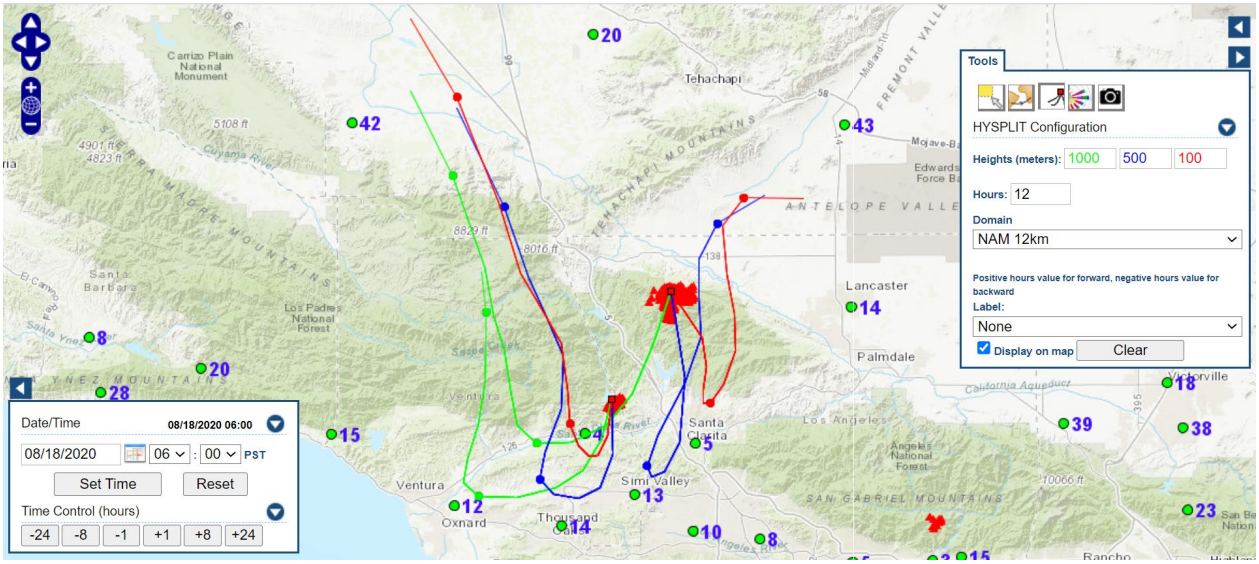


Figure A3: HYSPLIT 12-hour back trajectories from the Simi Valley monitoring site beginning August 18, 2020 at 10:00 AM PST using the NAM 12km domain for height levels of 1000m, 500m, and 100m (using the AirNowTech Navigator). Colored dots indicate monitoring station locations with available hourly O_3 measurements from this time; concentrations in ppb measured at the beginning hour are provided as blue numbers. Red triangles indicate active HMS fire detections from August 18, 2020.

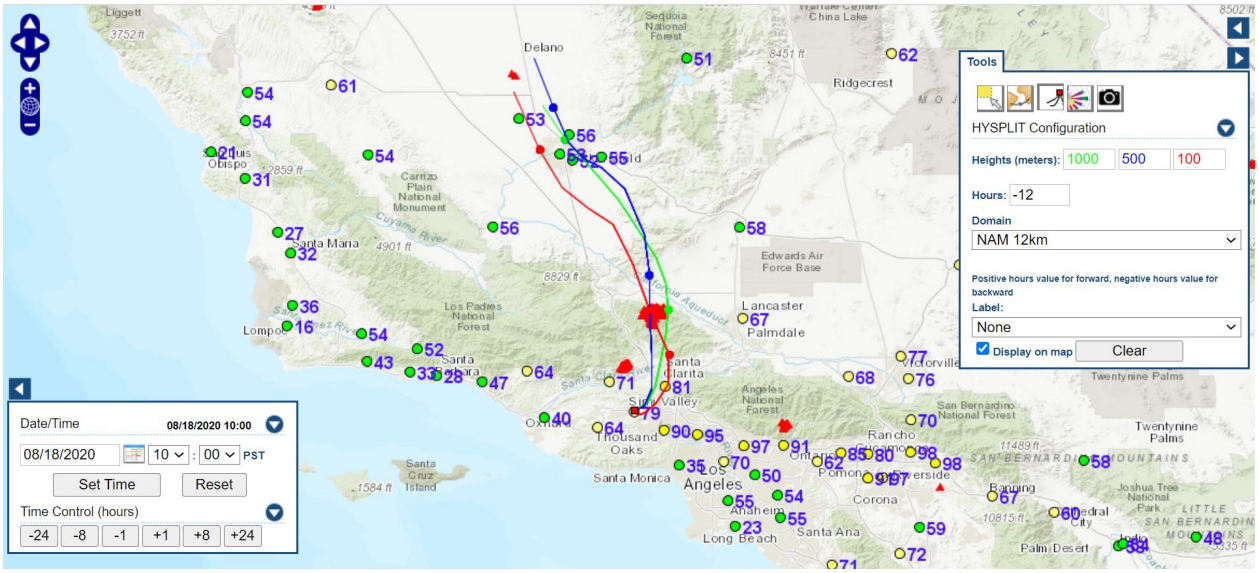
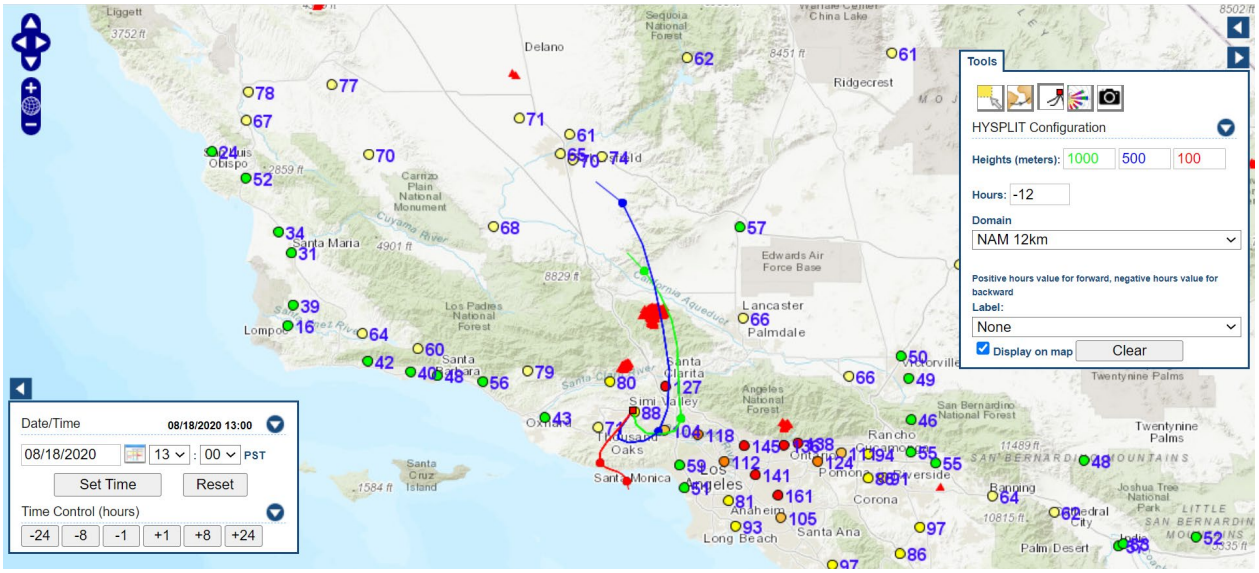


Figure A4: HYSPLIT 12-hour back trajectories from the Simi Valley monitoring site beginning August 18, 2020 at 1:00 PM PST using the NAM 12km domain for height levels of 1000m, 500m, and 100m (using the AirNowTech Navigator). Colored dots indicate monitoring station locations with available hourly O_3 measurements from this time; concentrations in ppb measured at the beginning hour are provided as blue numbers. Red triangles indicate active HMS fire detections from August 18, 2020.



ENCLOSURE: TECHNICAL SUPPORT DOCUMENT FOR EPA CONCURRENCE ON O_3 EXCEEDANCE MEASURED IN VENTURA COUNTY, CALIFORNIA ON AUGUST 21, 2020 AS AN EXCEPTIONAL EVENT

On December 8, 2021, the California Air Resources Board (CARB) submitted an exceptional event demonstration for exceedance of the 2008 8-hour ozone (O_3) National Ambient Air Quality Standard (NAAQS) of 0.075 parts per million (ppm) that occurred at the Simi Valley monitoring site on August 21, 2020.[1] The demonstration submitted by CARB stated that the exceedance measured on August 21, 2020 was caused by multiple wildfires burning in California, including the Holser, Lake, CZU Lightning Complex, LNU Lightning Complex, River, Salt, Woodward, Carmel, SCU Lightning Complex, and Dolan fires.[2] Under the Exceptional Events Rule, air agencies can request the exclusion of event-influenced data, and the EPA can agree to exclude these data, from the data set used for certain regulatory decisions. The remainder of this document summarizes the Exceptional Events Rule requirements, the event and the EPA's review process.

EXCEPTIONAL EVENTS RULE REQUIREMENTS

The EPA promulgated the Exceptional Events Rule in 2007, pursuant to the 2005 amendment of Clean Air Act (CAA) Section 319. In 2016, the EPA finalized revisions to the Exceptional Events Rule. The 2007 Exceptional Events Rule and 2016 Exceptional Events Rule revisions added sections 40 CFR §50.1(j)-(r); §50.14; and §51.930 to title 40 of the Code of Federal Regulations (CFR). These sections contain definitions, criteria for EPA approval, procedural requirements, and requirements for air agency demonstrations. The EPA reviews the information and analyses in the air agency's demonstration package using a weight of evidence approach and decides to concur or not concur. The demonstration must satisfy all of the Exceptional Events Rule criteria for the EPA to concur with excluding the air quality data from regulatory decisions.

Under 40 CFR §50.14(c)(3)(iv), the air agency demonstration to justify exclusion of data must include:

A. "A narrative conceptual model that describes the event(s) causing the exceedance or violation and a discussion of how emissions from the event(s) led to the exceedance or violation at the affected monitor(s);"

B. "A demonstration that the event affected air quality in such a way that there exists a clear causal relationship between the specific event and the monitored exceedance or violation;"

C. "Analyses comparing the claimed event-influenced concentration(s) to concentrations at the same monitoring site at other times" to support requirement (B) above;

[1] "Exceptional Events Demonstration for Ozone Exceedances Southern California 2020 Wildfire Events," (December 8, 2021) ("demonstration")." The demonstration also includes exceptional events analyses for other California nonattainment areas for the 2008 and/or 2015 NAAQS. The EPA's evaluation of the information presented in the demonstration is reflected in five separate technical support documents.

[2] See demonstration, pp. 70, 110

D. "A demonstration that the event was both not reasonably controllable and not reasonably preventable;" and

E. "A demonstration that the event was a human activity that is unlikely to recur at a particular location or was a natural event."[3]

In addition, the air agency must meet several procedural requirements, including:

1. submission of an Initial Notification of Potential Exceptional Event and flagging of the affected data in the EPA's Air Quality System (AQS) as described in 40 CFR §50.14(c)(2)(i),

2. completion and documentation of the public comment process described in 40 CFR §50.14(c)(3)(v), and

3. implementation of any relevant mitigation requirements as described in 40 CFR §51.930.

For data influenced by exceptional events to be excluded from use in initial area designations, air agencies must also meet the initial notification and demonstration submission deadlines specified in Table 2 to 40 CFR §50.14. We include below a summary of the Exceptional Events Rule criteria, including those identified in 40 CFR §50.14(c)(3)(iv).

Regulatory Significance

The 2016 Exceptional Events Rule includes regulatory language that applies the provisions of CAA section 319 to a specific set of regulatory actions. As identified in 40 CFR §50.14(a)(1)(i), these regulatory actions include initial area designations and redesignations; area classifications; attainment determinations (including clean data determinations); attainment date extensions; findings of State Implementation Plan (SIP) inadequacy leading to a SIP call; and other actions on a case-by-case basis as determined by the Administrator. Air agencies and the EPA should discuss the regulatory significance of an exceptional events demonstration during the Initial Notification of Potential Exceptional Event prior to the air agency submitting a demonstration for the EPA's review.

Narrative Conceptual Model

The 2016 Exceptional Events Rule directs air agencies to submit, as part of the demonstration, a narrative conceptual model of the event that describes and summarizes the event in question and provides context for analyzing the required statutory and regulatory technical criteria. Air agencies may support the narrative conceptual model with summary tables or maps. For wildfire O_3 events, the EPA recommends that the narrative conceptual model also discuss the interaction of emissions, meteorology, and chemistry of event and non-event O_3 formation in the area, and,

[3] A natural event is further described in 40 CFR 50.1(k) as "an event and its resulting emissions, which may recur at the same location, in which human activity plays little or no direct causal role. For purposes of the definition of a natural event, anthropogenic sources that are reasonably controlled shall be considered to not play a direct role in causing emissions."

under 40 CFR §50.14(a)(1)(i), must describe the regulatory significance of the proposed data exclusion.

Clear Causal Relationship and Supporting Analyses

The EPA considers a variety of evidence when evaluating whether there is a clear causal relationship between a specific event and the monitored exceedance or violation. For wildfire O_3 events, air agencies should compare the O_3 data requested for exclusion with seasonal and annual historical concentrations at the air quality monitor to establish a clear causal relationship between the event and monitored data. In addition to providing this information on the historical context for the event-influenced data, air agencies should further support the clear causal relationship criterion by demonstrating that the wildfire's emissions were transported to the monitor, that the emissions from the wildfire influenced the monitored concentrations, and, in some cases, air agencies may need to provide evidence of the contribution of the wildfire's emissions to the monitored O_3 exceedance or violation.

For wildfire O_3 events, the EPA has published a guidance document that provides three different tiers of analyses that apply to the "clear causal relationship" criterion within an air agency's exceptional events demonstration.[4] This tiered approach recognizes that some wildfire events may be more clear and/or extreme and, therefore, require relatively less evidence to satisfy the rule requirements. If a wildfire/O_3 event satisfies the key factors for either Tier 1 or Tier 2 clear causal analyses, then those analyses are the only analyses required to support the clear causal relationship criterion within an air agency's demonstration for that particular event. Other wildfire/O_3 events will be considered based on Tier 3 analyses.

- Tier 1: Wildfires that clearly influence monitored O_3 exceedances or violations when they occur in an area that typically experiences lower O_3 concentrations.
    - *Key Factor*: seasonality and/or distinctive level of the monitored O_3 concentration. The event-related exceedance occurs during a time of year that typically has no exceedances, or is clearly distinguishable (*e.g.*, 5-10 parts per billion (ppb) higher) from non-event exceedances.
    - In these situations, O_3 impacts should be accompanied by clear evidence that the wildfire's emissions were transported to the location of the monitor.

- Tier 2: The wildfire event's O_3 influences are higher than non-event related concentrations, and fire emissions compared to the fire's distance from the affected monitor indicate a clear causal relationship.
    - *Key Factor 1*: fire emissions and distance of fire(s) to affected monitoring site location(s). Calculated fire emissions of nitrogen oxides (NO_x) and reactive-volatile organic compounds (VOC) in tons per day (Q) divided by the distance from the fire to the monitoring site (D) should be equal to or greater than 100 tons per day/kilometers ($Q/D \geq 100$ tpd/km). The guidance document provides additional information on the calculation of Q/D.

[4] "Guidance on the Preparation of Exceptional Events Demonstrations for Wildfire Events that May Influence Ozone Concentrations" (September 2016) ("wildfire O_3 guidance document").

- *Key Factor 2*: comparison of the event-related O_3 concentration with non-event related high O_3 concentrations. The exceedance due to the exceptional event:
  - is in the 99th or higher percentile of the 5-year distribution of O_3 monitoring data, OR
  - is one of the four highest O_3 concentrations within 1 year (among those concentrations that have not already been excluded under the Exceptional Events Rule, if any).
- In addition to the analysis required for Tier 1, the air agency should supply additional evidence to support the weight of evidence that emissions from the wildfire affected the monitored O_3 concentration.

- Tier 3: The wildfire does not fall into the specific scenarios (i.e., does not meet the key factors) that qualify for Tier 1 or Tier 2, but the clear causal relationship criterion can still be satisfied by a weight of evidence showing.
  - In addition to the analyses required for Tier 1 and Tier 2, an air agency may further support the clear causal relationship with additional evidence that the fire emissions caused the O_3 exceedance.

Not Reasonably Controllable or Preventable

The Exceptional Events Rule requires that air agencies establish that the event be both not reasonably controllable and not reasonably preventable at the time the event occurred. This requirement applies to both natural events and events caused by human activities; however, it is presumed that wildfires on wildland will satisfy both factors of the "not reasonably controllable or preventable" element unless evidence in the record clearly demonstrates otherwise.[5]

Natural Event

According to the CAA and the Exceptional Events Rule, an exceptional event must be "an event caused by human activity that is unlikely to recur at a particular location *or* a natural event" (emphasis added). The 2016 Exceptional Events Rule includes in the definition of wildfire that "[a] wildfire that predominantly occurs on wildland is a natural event." Once an agency provides evidence that a wildfire on wildland occurred and demonstrates that there is a clear causal relationship between the measurement under consideration and the event, the EPA expects minimal documentation to satisfy the "human activity that is unlikely to recur at a particular location or a natural event" element. The EPA will address wildfires on other lands on a case-by-case basis.

EPA REVIEW OF EXCEPTIONAL EVENTS DEMONSTRATION

On March 15, 2021, CARB submitted an Initial Notification of a potential Exceptional Event for an exceedance of the 2008 8-hour O_3 NAAQS that occurred at the Simi Valley monitoring site

[5] A wildfire is defined in 40 CFR 50.1(n) as "any fire started by an unplanned ignition caused by lightning; volcanoes; other acts of nature; unauthorized activity; or accidental, human-caused actions, or a prescribed fire that has developed into a wildfire. A wildfire that predominantly occurs on wildland is a natural event." Wildland is defined in 40 CFR 50.1(o) as "an area in which human activity and development are essentially non-existent, except for roads, railroads, power lines, and similar transportation facilities. Structures, if any, are widely scattered."

within Ventura County, California on August 21, 2020.[6] On December 8, 2021, CARB submitted an exceptional event demonstration for one exceedance of the 2008 8-hour O_3 NAAQS that occurred at the Simi Valley monitoring site within Ventura County, California (CA) on August 21, 2020.[7]

Regulatory Significance

The EPA determined that data exclusion of the exceedance referenced in the Initial Notification may have a regulatory significance for determination of attainment by the attainment date for the Ventura County, CA Serious nonattainment area for the 2008 O_3 NAAQS and worked with CARB to identify the relevant exceedance and monitoring site affected.[8] Table 1 summarizes the exceedance measured at the Simi Valley monitoring site on August 21, 2020, that CARB included in the demonstration.

Table 1: 2008 8-hour O_3 NAAQS Exceedance Summary

Exceedance Date	Monitoring Site Name	AQS ID	2008 8-hour Avg. (ppm)
August 21, 2020	Simi Valley	06-111-2002	0.082

Narrative Conceptual Model

The demonstration submitted by CARB provided a narrative conceptual model in the "Overview/Introduction," "Background," and "Narrative Conceptual Model" sections of the demonstration to describe how emissions from multiple wildfires burning in Central and Southern California, including the Holser, Lake, CZU Lightning Complex, LNU Lightning Complex, River, Salt, Woodward, Carmel, SCU Lightning Complex, and Dolan fires, caused the O_3 exceedance at the Simi Valley monitoring site. The demonstration addressed the regulatory significance of the exceptional event in "Overview/Introduction" indicating that the exclusion of wildfire events in 2018 and 2020 would affect a determination of attainment for the Ventura County, CA Serious nonattainment area for the 2008 O_3 NAAQS.[9] The "Overview/Introduction" and "Background" chapters provided information to support the narrative conceptual model including characteristics of the nonattainment area, such as geography, topography, meteorology, the ambient O_3 monitoring network, typical non-event O_3 formation conditions and patterns, seasonal O_3 variations, and emissions of O_3 precursors.[10]

The narrative conceptual model described characteristics of the event. This included a summary of the occurrences of wildfires in California and specific descriptions of individual wildfires that generated smoke contributing to the O_3 exceedance at the Simi Valley monitoring site on August 21, 2020.[11] The demonstration provided tables for the actively burning fires during the time of the exceedance which include the fire name, source, start date, containment date, location, and total acreage burned along with maps of the fire perimeters.[12] The narrative conceptual model

[6] See email from Sylvia Vanderspek, CARB, to Gwen Yoshimura, EPA Region 9, dated March 15, 2021.
[7] See letter from Michael Benjamin, CARB, to Matthew Lakin, EPA Region 9, dated December 8, 2021.
[8] See letter from Elizabeth Adams, EPA Region 9, to Sylvia Vanderspek, CARB, dated April 21, 2021.
[9] See demonstration, pp. 2, 4-6.
[10] See demonstration pp. 10-17, 19-22.
[11] See demonstration pp. 23-26.
[12] See demonstration pp. 27-66.

also included tables displaying meteorological conditions on the dates of the fires and figures displaying Hybrid Single Particle Lagrangian Integrated Trajectory (HYSPLIT) modeling results. National Aeronautics Space Administration (NASA) Terra Moderate Resolution Imaging Spectroradiometer (MODIS) satellite imagery of the entire California region was shown for August 19 and 20, 2021, indicating worsening smoke conditions throughout much of California, including Simi Valley, just prior to August 21, 2021.[13] HYSPLIT backward trajectory modeling results overlaid on Hazard and Mapping System (HMS) satellite-derived smoke layers imagery indicated multi-layer atmospheric transport from areas in which heavy smoke from wildfire emissions were transported to the Simi Valley monitoring site on the exceptional event date requested for exclusion and indicated that heavy smoke was also present throughout California, including Simi Valley located in the South Central Coast Air Basin.[14] Along with these graphics, the narrative conceptual model included a narrative describing how high pressure aloft slowly weakened allowing winds to shift to a southeasterly monsoonal flow, transporting dense smoke from the active wildfires up north southward along the coast, with O_3 and O_3 precursors being mixed down to the surface on August 21, 2020.[15]

The narrative conceptual model included charts showing event related 1-hour O_3 and particulate matter less than or equal to 2.5 microns ($PM_{2.5}$) concentration trends beginning several days before the event (August 15, 2020) and continuing through several days after the event (August 24, 2020). The concentrations of O_3 and $PM_{2.5}$ increased until the levels became significantly elevated from August 18, 2020, through August 22, 2020, at the Simi Valley monitoring site. However, levels prior to August 18, 2020, and after August 22, 2020, were considerably lower; the demonstration interpreted this to suggest that the wildfire smoke had a strong influence on the measured O_3 and $PM_{2.5}$ concentrations at the Simi Valley monitoring site during these dates. The demonstration also included a chart of 8-hour O_3 design values at the Simi Valley monitoring site from 2009 to 2020 suggesting that Simi Valley O_3 concentrations trends have been decreasing and trending towards attainment for the 2008 O_3 NAAQS. Furthermore, the demonstration noted that Simi Valley's 2020 8-hour O_3 design value (reflecting data from 2018 through 2020) would meet the 2008 O_3 NAAQS if the exceptional events requested in the demonstration are excluded. [16]

The narrative conceptual model also included discussions and summaries of daily meteorological data, such as temperatures and wind speeds, and 1-hour and 8-hour O_3 concentrations from the Simi Valley monitoring site from August 15, 2020, to August 24, 2020. The maximum daily wind speed on August 21 was slightly lower than other dates in the range, as well as slightly below the average maximum wind speed for August (10.3 miles per hour (mph) versus 8.5 mph).[17] The maximum temperature measured on August 21 was significantly higher than the average maximum temperature for August (97 degrees Fahrenheit versus 89 degrees Fahrenheit). The demonstration compares August 15 with August 21; while August 15 measured a maximum 8-hour O_3 concentration 0.032 ppm lower than August 21, the maximum temperature was 5.6 degrees higher and maximum wind speeds only 1.8 mph higher.[18] The demonstration concluded

[13] See demonstration, pp.74-75.
[14] See demonstration, pp. 69, 76-77; Appendix D, pp, 188-238, 242-245.
[15] See demonstration, pp. 70-77.
[16] See demonstration, pp. 90-92.
[17] See demonstration, pp. 94, 96.
[18] *Id*.

that given the minor differences in meteorological conditions between August 15 and August 21, it is unlikely August 21 would have measured such high ozone under normal conditions.[19]

The narrative conceptual model included an air quality advisory issued by Ventura County Air Pollution Control District (APCD) describing unhealthy air quality due wildfire smoke throughout Ventura County, as well as examples of news and social media coverage of the 2020 wildfires in Southern California.[20]

Overall, the demonstration contained the elements required for inclusion in the conceptual model portion of the exceptional events demonstration.

Table 2: Documentation of the Narrative Conceptual Model

Exceedance Date	Demonstration Citation	Quality of Evidence	Criterion Met?
August 21, 2020	"Overview/Introduction": pp. 2, 4-6 "Background": pp. 10-16, 19-22 "Narrative Conceptual Model": pp. 23-77, 89-92, 96-101 Appendix C: pp. 159-160 Appendix D: pp. 188-238, 242-245 Appendix F: pp. 263-269, 274-287	Sufficient	Yes

Clear Causal Relationship

The demonstration included several analyses to support a clear causal relationship between the wildfire event and the monitored exceedance. These analyses were presented in the "Clear Causal Relationship" section of the demonstration.

Comparison with historical concentrations

The demonstration included a comparison with historical concentrations, as required by 40 CFR §50.14(c)(3)(iv)(C). The demonstration compared O_3 concentrations at the Simi Valley monitoring site on the 2020 wildfire exceptional event day to historical non-event O_3 concentrations from 2015-2020.[21] This included a graph of daily maximum 8-hour average concentrations over the six-year period by day of the year, along with the level of the NAAQS and the 99th percentile value at the site. In Figure IV-2, the O_3 concentration at the monitor on August 21, 2020 (0.082 ppm) was shown to be above the 2015-2020 99th percentile value of 0.076 ppm. However, the O_3 concentration on August 21, 2020, was not clearly distinguishable (at least 0.005 ppm higher) from non-event exceedances and elevated O_3 concentrations are not uncommon at this time of the year.

Tier 1: Key Factor

To meet the key factor for a Tier 1 analysis, exceedances should be clearly higher than other non-event related exceedances or occur during a time of year that typically experiences no exceedances. The exceedance identified in this demonstration for August 21, 2020, occurs during a season when higher O_3 values have historically been observed at the Simi Valley monitoring

[19] See demonstration pp. 93-97.
[20] See demonstration, pp. 99, 101; Appendix F, pp. 263-269, 274-287.
[21] See demonstration, p. 105.

site. While the monitored exceedance is above the 99th percentile of concentrations measured in the past six years, it does not exceed non-event exceedance concentrations by at least 5 ppb.[22] Therefore, the exceedance does not meet the Tier 1 Key Factor and additional evidence beyond a Tier 1 analysis is needed to support the clear causal relationship.

Tier 2: Key Factors

The demonstration included an evaluation of the Tier 2 Key Factors. For Tier 2 Key Factor 1, the demonstration provided an analysis of fire emissions (Q) and distance (D) of the wildfires to the monitoring site locations. The Q/D value is generally calculated by dividing wildfire emissions (in tpd) by the distance between the wildfire and the monitoring site (in kilometers [km]). Daily Q/D values were calculated by the EPA using daily wildland fire emissions input files originally created for the Community Multiscale Air Quality (CMAQ) modeling system. The resulting calculations were shared with CARB to assist in demonstration development. CMAQ input files included associated fire's daily emissions of nitrogen oxide (NO), nitrogen dioxide (NO_2), and reactive organic gases (ROG) at release points corresponding to wildfire locations. Q/D was calculated for each CMAQ input release point by calculating the distance between release point locations and gridded receptor locations and dividing the total emissions by this distance. An aggregated daily Q/D was then calculated by summing the individual Q/D values for each release point. An "effective Q/D" value was calculated at monitoring site receptor locations by accounting for periods where multiple days of wildfire smoke buildup impacted the monitoring site for up to three total days; the dates to include in each daily "effective Q/D" were based on meteorology and transport analyses, with the rationale further outlined in the demonstration.[23] The distance-weighted sum for the date requested of August 21, 2020, is 67 tpd/km, which is below the Tier 2 Key Factor 1 screening value of 100 tons per day of NO_x and VOC per km. Therefore, the event exceedance does not meet Tier 2 Key Factor 1.

For Tier 2 Key Factor 2, the demonstration included evidence that the exceedance is at or above the 99th percentile from the past five years of O_3 season data (2015-2019) or among the four highest concentrations measured at the site in 2020. In the demonstration, CARB determined an "adjusted 4th high" corresponding to the 4th highest non-event concentration monitored in 2020, excluding the exceedances for which CARB submitted an exceptional events demonstration.[24] CARB stated that dates impacted by exceptional events should not count against the tally of the four highest O_3 concentrations measured in 2020 because these exceedance were caused by contributions from wildfire emissions.[25] This rationale is supported given that the purpose of the test is to show that the exceedances are high compared to non-event data. Since the excluded dates are all included in the demonstration being evaluated for the Ventura County, CA Serious nonattainment area, each individual date would not count towards the four highest concentrations if concurred on by the EPA.[26] As shown in Table IV-4 of the demonstration, the monitored O_3 concentration on August 21, 2020 exceeds the adjusted 4th high O_3 concentration at the Simi Valley monitoring site in 2020.[27] Therefore, the event exceedance meets Tier 2 Key Factor 2.

[22] See demonstration, pp. 102-103, 105.
[23] See demonstration, pp. 106-107, 110-111.
[24] See demonstration, pp. 112-113.
[25] See demonstration, p. 111.
[26] This demonstration also includes analyses for exceptional event dates that occurred at the Simi Valley monitoring site on August 18, 2020 and October 2-4, 2020. These exceptional event dates are evaluated by the EPA in separate TSDs.
[27] See demonstration, pp. 112-113.

Based on the analysis of the Key Factors for Tier 2, the EPA's wildfire O_3 guidance document indicates that a Tier 3 analysis is appropriate for this event. As described below, the demonstration included the required elements for a clear causal relationship analysis based on the EPA's wildfire O_3 guidance document. This includes evidence to support that (1) wildfire emissions were transported from the wildfire to the monitor; (2) wildfire emissions affected the monitor; and (3) wildfire emissions caused the O_3 exceedance.

Tier 3 analysis: Evidence of transport of wildfire emissions from the wildfire to the monitor
The demonstration presented analyses in the Narrative Conceptual Model using backward trajectory and forward trajectory modeling.[28] HYSPLIT back trajectories originating at the monitor location at three elevations (1000 meters (m), 500m, and 100m) show the likely path of air parcels, 36 hours prior to the first hour of the exceeding 8-hour time period and 36 hours prior to the hour of maximum concentrations within that 8-hour time period on August 21, 2020; Figure III-27 overlays one set of these back trajectories on National Oceanic and Atmospheric Administration (NOAA) HMS Fire and Smoke Product imagery. HYSPLIT forward trajectories beginning at the wildfire locations at the same three elevations show the most likely center path air parcels travelled for 36 to 48 hours, starting at 4:00 PM PST the day before the exceedance and at 4:00 AM PST the day of the exceedance; Figure III-26 overlays one set of these forward trajectories on satellite imagery to provide a visual analysis of whether smoke emitted from the fires may have impacted the Simi Valley monitoring site.

The forward trajectories (Figure III-26), shown for August 20, 2020, depict trajectories which leave numerous wildfires, including the SCU Lightning Complex, Holser, and Lake fires, and move southeast towards Simi Valley and off the coast west of Simi Valley.[29] Additional forward trajectories from the wildfire locations during the event period (including August 21, 2020) can be found in Appendix D.[30] The backward trajectories (Figure III-27), shown for August 21, 2020, depict a 100m backward trajectory for Simi Valley that starts off the coast slightly west of the Simi Valley, which is shown to have high smoke concentrations by the HMS model. The 500m trajectory starts in central California and travels south, through areas shown to have high smoke concentrations by the HMS model, to arrive at Simi Valley.[31] Lastly, the 1000m backward trajectory for Simi Valley originated in a light/medium smoke area off the coast and traverses through areas of high smoke before arriving at Simi Valley. Overall, the backward and forward trajectories support that the wildfire emissions were transported to the Simi Valley monitoring site on the day requested for exclusion as an exceptional event.

Tier 3 analysis: Evidence that the wildfire emissions affected the monitor
The demonstration provided evidence in the Narrative Conceptual Model and Clear Causal Relationship chapters of wildfire emissions affecting the Simi Valley monitoring site.[32] The demonstration included figures comparing the daily diurnal pattern of 1-hour O_3 concentrations on August 21, 2021 to hourly diurnal O_3 percentiles from 2015-2019, which included the 5th, 50th, and 95th percentile values.[33] Figure IV-10 indicates that between 6:00 AM PST and 9:00

[28] See demonstration, pp. 72, 76-77.
[29] See demonstration, p. 76.
[30] See demonstration, Appendix D, pp. 191-238.
[31] See demonstration, p. 77.
[32] See demonstration, pp. 90-91, 133-134.
[33] See demonstration, p. 118.

AM PST on the morning of August 21, 2021, concentrations rose from approximately 50th percentile of the historical concentration profile to nearly the 95th percentile. After 9:00AM PST (the first hour included in the exceedance average), O_3 concentrations continued to rise to 109 ppb at approximately 12:00 PM PST. Concentrations over the next three hours gradually tapered down to a 95th percentile level with the last hour remaining around the 50th percentile. Although the 1-hour O_3 concentrations on August 21, 2020, generally follow the diurnal profile of historical seasonal data, peak O_3 concentrations on this day are more pronounced and exceed the 95th percentile by approximately 30 ppb.

The demonstration also provided seasonal 1-hour $PM_{2.5}$ concentrations for August 2015-2019 compared with the 1-hour $PM_{2.5}$ concentrations on August 21, 2020 (Figure IV-26) measured at the Simi Valley monitoring site.[34] Historical seasonal 1-hour $PM_{2.5}$ diurnal patterns show concentrations are generally consistent throughout the day, at around 10 $\mu g/m^3$, with a minor peak around 7:00 AM PST. The 1-hour $PM_{2.5}$ concentrations measured on August 21, 2021, deviate from the norm, with concentrations gradually increasing in the morning before sharply peaking around 12:30PM PST, with concentrations around 25-35 $\mu g/m^3$ sustained for the remainder of the day. The $PM_{2.5}$ concentration trendline is very similar to the O_3 trendline with concentrations exceeding the 95th percentile average at approximately 9:00AM PST with a sharp increase to peak at approximately 12:30 PM PST of approximately 47 $\mu g/m^3$, approximately two times higher the 95th percentile value at approximately the same time as the 1-hr O_3 maximum. After the peak concentration, $PM_{2.5}$ concentrations tapered off as was the case for ozone and remained above the 95th percentile trendline through the evening hours. The abnormal 1-hour pattern and highly elevated concentrations of $PM_{2.5}$ support that smoke was impacting the monitor.

Additionally, the demonstration provided evidence that the wildfire emissions affected the monitoring using data obtained through non-regulatory monitoring at Port Hueneme, which is approximately 30 miles west-southwest of the Simi Valley monitoring site. At Port Hueneme, PM and black carbon concentrations were elevated for August 20-23 (Figure IV-32), which strongly suggest suggests the presence of wildfire smoke at ground level in areas near Simi Valley.[35] In addition to being elevated, the difference in signal between the two aethalometer channels (the black carbon channel and the wood smoke channel) provides strong support that the elevated levels of $PM_{2.5}$ and black carbon observed in the area were due to wildfire smoke.

The O_3 hourly concentration and percentile profile analysis, $PM_{2.5}$ hourly concentration and percentile profile analysis, and black carbon analysis support that wildfire emissions reached the ground and affected measurements at the Simi Valley monitoring site on August 21, 2020.

Tier 3 analysis: Additional evidence that the wildfire emissions caused the O_3 exceedance
The demonstration included additional evidence to support that the wildfire emissions specifically affected O_3 concentrations at the exceeding Simi Valley monitoring site and caused the O_3 exceedance. The demonstration included an analysis of coincident increases in $PM_{2.5}$ and O_3 on the event day, National Weather Service (NWS) area forecast discussions, and Navy Aerosol Analysis and Prediction System (NAAPS) modeling.

[34] See demonstration, p. 129.
[35] See demonstration, pp. 133-134.

Figure III-36 shows the 1-hour O_3 and 1-hour $PM_{2.5}$ concentrations measured at the Simi Valley monitoring site from August 18, 2020, to August 22, 2020. On August 20, 2020, and August 21, 2020, peak concentrations rose well above the 2008 8-hour O_3 NAAQS to approximately 0.087 ppm. Simultaneous large increases in O_3 and $PM_{2.5}$ starting on August 20, 2020, through August 21, 2022, as compared to the days preceding and following the event suggest the elevated O_3 was a result of the impact of wildfire emissions at the monitor. Furthermore, monitor data showed a clear correlation with increased $PM_{2.5}$ concentrations and O_3 concentrations during this time period.

As additional evidence to support that wildfire emissions affected the Simi Valley monitoring site on August 21, 2020, the demonstration included a special weather statement issued by the National Weather Service Los Angeles/Oxnard office on August 20, 2020. The special weather statement provides evidence of observed wildfire smoke moving over Ventura County beginning on August 20, 2020. Results from the Navy Aerosol Analysis and Prediction System (NAAPS) Global Aerosol Model were also presented to show a predicted increase in particulate matter in the atmosphere.[36] The NAAPS outputs include a Smoke Surface Concentration map (Figure IV-36), which simulates elevated smoke concentrations at the surface for much of California, including the Ventura County area, for August 21, 2020.

Overall, the correlation between elevated $PM_{2.5}$ and O_3 concentrations during the event period, special weather statements, and NAAPS modeling results help support that wildfire emissions from the wildfires burning throughout California reached ground level and caused the O_3 exceedances observed at the Simi Valley monitor on August 21, 2020.

Conclusion

The analyses included in the demonstration, specifically, temporal ambient O_3 and $PM_{2.5}$ monitoring data, Q/D analyses, HYSPLIT backward and forward trajectory analyses, NOAA HMS fire and smoke product imagery, NASA's Terra MODIS satellite imagery, paired PM and black carbon analyses from non-regulatory ambient monitoring, NWS special weather statements, and the NAAPS Global Aerosol Model, sufficiently demonstrate a clear causal relationship between the emissions generated by several large wildfires throughout California, including the Holser, Lake, CZU Lightning Complex, LNU Lightning Complex, River, Salt, Woodward, Carmel, SCU Lightning Complex, and Dolan fires, and the exceedance measured at the Simi Valley monitoring site.

Table 3: Documentation of the Clear Causal Relationship criterion

Exceedance Date	**Demonstration Citation**	**Quality of Evidence**	**Criterion Met?**
August 21, 2020	"Narrative Conceptual Model": pp. 70-77, 89-92, 96-101 "Clear Causal Relationship": pp. 105-139 Appendix C: pp. 163-187 Appendix D: pp. 188-244	Sufficient	Yes

[36] See demonstration, pp. 135-138.

Not Reasonably Controllable or Preventable

The Exceptional Events Rule presumes that wildfire events on wildland are not reasonably controllable or preventable [40 CFR §50.14(b)(4)]. The demonstration provided evidence that the wildfire event meets the definition of wildfire [40 CFR §50.1(n)]. Specifically, the demonstration included maps and descriptions of the wildfires, along with figures showing wildfire boundaries overlaid upon land ownership and wildland-urban interface layers to demonstrate that the fires occurred on wildland or in the urban/wildland interface.[37] The demonstration described that CARB is not aware of any evidence clearly demonstrating that prevention or control efforts beyond those actually made would have been reasonable.[38] Therefore, the documentation provided sufficiently demonstrates that the event was not reasonably controllable and not reasonably preventable.

Table 4: Documentation of the Not Reasonably Controllable or Preventable criterion

Exceedance Date	Demonstration Citation	Quality of Evidence	Criterion Met?
August 21, 2020	"Narrative Conceptual Model": pp. 25-68 "Not reasonably Controllable and/or Not Reasonably Preventable": p. 140	Sufficient	Yes

Natural Event

The definition of "wildfire" at 40 CFR §50.1(n) states, "A wildfire that predominantly occurs on wildland is a natural event." As previously described, the demonstration included documentation that the event meets the definition of a wildfire and occurred predominantly on wildland and has therefore shown that the event was a natural event.

Table 5: Documentation of the Natural Event criterion

Exceedance Date	Demonstration Citation	Quality of Evidence	Criterion Met?
August 21, 2020	"Narrative Conceptual Model": pp 67-68 "Natural Event/Human Activity Unlikely to Recur": p. 140	Sufficient	Yes

Schedule and Procedural Requirements

In addition to technical demonstration requirements, 40 CFR §50.14(c) and 40 CFR §51.930 specify schedule and procedural requirements an air agency must follow to request data exclusion. Table 6 outlines the EPA's evaluation of these requirements.

[37] See demonstration, pp. 67-68.
[38] See demonstration, p. 140.

Table 6: Schedules and Procedural Criteria

	Reference	Demonstration Citation	Criterion Met?
Did the agency provide prompt public notification of the event?	40 CFR §50.14 (c)(1)(i)	"Narrative Conceptual Model": pp. 97-99; "Public Notification": p. 140; Appendix B: pp.156-158; Appendix F: pp. 262, 267-268, 274-279, 282-287	Yes
Did the agency submit an Initial Notification of Potential Exceptional Event and flag the affected data in the EPA's Air Quality System (AQS)?	40 CFR §50.14 (c)(2)(i)	Appendix A: pp. 150-153	Yes
Did the initial notification and demonstration submittals meet the deadlines for data influenced by exceptional events for use in initial area designations, if applicable? Or the deadlines established by the EPA during the Initial Notification of Potential Exceptional Events process, if applicable?	40 CFR §50.14 Table 2 40 CFR §50.14 (c)(2)(i)(B)	See letter from Sylvia Vanderspek, CARB, to Elizabeth Adams, EPA, dated March 15, 2021	Yes
Was the public comment process followed and documented? • Did the agency document that the comment period was open for a minimum of 30 days? • Did the agency submit to the EPA any public comments received? • Did the state address comments disputing or contradicting factual evidence provided in the demonstration?	40 CFR §50.14 (c)(3)(v)	"Public Notification": p.140; See letter from Michael Benjamin, CARB, to Matthew Lakin, dated December 8, 2021.	Yes
Has the agency met requirements regarding submission of a mitigation plan, if applicable?	40 CFR §51.930 (b)	NA	NA

Conclusion

The EPA has reviewed the documentation provided by CARB to support claims that smoke from several large wildfires throughout California, including the Holser, Lake, CZU Lightning Complex, LNU Lightning Complex, River, Salt, Woodward, Carmel, SCU Lightning Complex, and Dolan fire, in Southern and Central California caused an exceedance of the 2008 8-hour O_3 NAAQS at the Simi Valley monitoring site on August 21, 2020. The EPA has determined that the flagged exceedance at this monitoring site on this day satisfies the exceptional event criteria:

the event was a natural event, which affected air quality in such a way that there exists a clear causal relationship between the event and the monitored exceedance, and was not reasonably controllable or preventable. The EPA has also determined that CARB has satisfied the schedule and procedural requirements for data exclusion.

ENCLOSURE: TECHNICAL SUPPORT DOCUMENT FOR EPA CONCURRENCE ON O_3 EXCEEDANCES MEASURED IN VENTURA COUNTY, CALIFORNIA ON OCTOBER 2-4, 2020 AS EXCEPTIONAL EVENTS

On December 8, 2021, the California Air Resources Board (CARB) submitted an exceptional event demonstration for exceedances of the 2008 8-hour ozone (O_3) National Ambient Air Quality Standards (NAAQS) of 0.075 parts per million (ppm) that occurred at the Simi Valley monitoring site between October 2-4, 2020.[1] The demonstration submitted by CARB stated that the exceedances measured on October 2-4, 2020 were caused by numerous wildfires burning in Central and Southern California, most notably the Bobcat Fire.[2] Under the Exceptional Events Rule, air agencies can request the exclusion of event-influenced data, and the EPA can agree to exclude these data, from the data set used for certain regulatory decisions. The remainder of this document summarizes the Exceptional Events Rule requirements, the event, and the EPA's review process.

EXCEPTIONAL EVENTS RULE REQUIREMENTS

The EPA promulgated the Exceptional Events Rule in 2007, pursuant to the 2005 amendment of Clean Air Act (CAA) Section 319. In 2016, the EPA finalized revisions to the Exceptional Events Rule. The 2007 Exceptional Events Rule and 2016 Exceptional Events Rule revisions added sections 40 CFR §50.1(j)-(r); §50.14; and §51.930 to title 40 of the Code of Federal Regulations (CFR). These sections contain definitions, criteria for EPA approval, procedural requirements, and requirements for air agency demonstrations. The EPA reviews the information and analyses in the air agency's demonstration package using a weight of evidence approach and decides to concur or not concur. The demonstration must satisfy all of the Exceptional Events Rule criteria for the EPA to concur with excluding the air quality data from regulatory decisions.

Under 40 CFR §50.14(c)(3)(iv), the air agency demonstration to justify exclusion of data must include:

A. "A narrative conceptual model that describes the event(s) causing the exceedance or violation and a discussion of how emissions from the event(s) led to the exceedance or violation at the affected monitor(s);"

B. "A demonstration that the event affected air quality in such a way that there exists a clear causal relationship between the specific event and the monitored exceedance or violation;"

C. "Analyses comparing the claimed event-influenced concentration(s) to concentrations at the same monitoring site at other times" to support requirement (B) above;

[1] "Exceptional Events Demonstration for Ozone Exceedances Southern California 2020 Wildfire Events," (December 8, 2021) ("demonstration")." The demonstration also includes exceptional events analyses for other California nonattainment areas for the 2008 and/or 2015 NAAQS. The EPA's evaluation of the information presented in the demonstration is reflected in five separate technical support documents.

[2] See demonstration, pp. 23, 69, 78-80.

D. "A demonstration that the event was both not reasonably controllable and not reasonably preventable;" and

E. "A demonstration that the event was a human activity that is unlikely to recur at a particular location or was a natural event."[3]

In addition, the air agency must meet several procedural requirements, including:

1. submission of an Initial Notification of Potential Exceptional Event and flagging of the affected data in the EPA's Air Quality System (AQS) as described in 40 CFR §50.14(c)(2)(i),

2. completion and documentation of the public comment process described in 40 CFR §50.14(c)(3)(v), and

3. implementation of any relevant mitigation requirements as described in 40 CFR §51.930.

For data influenced by exceptional events to be excluded form use in initial area designations, air agencies must also meet the initial notification and demonstration submission deadlines specified in Table 2 to 40 CFR §50.14. We include below a summary of the Exceptional Events Rule criteria, including those identified in 40 CFR §50.14(c)(3)(iv).

Regulatory Significance

The 2016 Exceptional Events Rule includes regulatory language that applies the provisions of CAA section 319 to a specific set of regulatory actions. As identified in 40 CFR §50.14(a)(1)(i), these regulatory actions include initial area designations and redesignations; area classifications; attainment determinations (including clean data determinations); attainment date extensions; findings of State Implementation Plan (SIP) inadequacy leading to a SIP call; and other actions on a case-by-case basis as determined by the Administrator. Air agencies and the EPA should discuss the regulatory significance of an exceptional events demonstration during the Initial Notification of Potential Exceptional Event prior to the air agency submitting a demonstration for the EPA's review.

Narrative Conceptual Model

The 2016 Exceptional Events Rule directs air agencies to submit, as part of the demonstration, a narrative conceptual model of the event that describes and summarizes the event in question and provides context for analyzing the required statutory and regulatory technical criteria. Air agencies may support the narrative conceptual model with summary tables or maps. For wildfire O_3 events, the EPA recommends that the narrative conceptual model also discuss the interaction of emissions, meteorology, and chemistry of event and non-event O_3 formation in the area, and,

[3] A natural event is further described in 40 CFR 50.1(k) as "an event and its resulting emissions, which may recur at the same location, in which human activity plays little or no direct causal role. For purposes of the definition of a natural event, anthropogenic sources that are reasonably controlled shall be considered to not play a direct role in causing emissions."

under 40 CFR §50.14(a)(1)(i), must describe the regulatory significance of the proposed data exclusion.

Clear Causal Relationship and Supporting Analyses

The EPA considers a variety of evidence when evaluating whether there is a clear causal relationship between a specific event and the monitored exceedance or violation. For wildfire O_3 events, air agencies should compare the O_3 data requested for exclusion with seasonal and annual historical concentrations at the air quality monitor to establish a clear causal relationship between the event and monitored data. In addition to providing this information on the historical context for the event-influenced data, air agencies should further support the clear causal relationship criterion by demonstrating that the wildfire's emissions were transported to the monitor, that the emissions from the wildfire influenced the monitored concentrations, and, in some cases, air agencies may need to provide evidence of the contribution of the wildfire's emissions to the monitored O_3 exceedance or violation.

For wildfire O_3 events, the EPA has published a guidance document that provides three different tiers of analyses that apply to the "clear causal relationship" criterion within an air agency's exceptional events demonstration.[4] This tiered approach recognizes that some wildfire events may be more clear and/or extreme and, therefore, require relatively less evidence to satisfy the rule requirements. If a wildfire/O_3 event satisfies the key factors for either Tier 1 or Tier 2 clear causal analyses, then those analyses are the only analyses required to support the clear causal relationship criterion within an air agency's demonstration for that particular event. Other wildfire/O_3 events will be considered based on Tier 3 analyses.

- Tier 1: Wildfires that clearly influence monitored O_3 exceedances or violations when they occur in an area that typically experiences lower O_3 concentrations.
    - *Key Factor*: seasonality and/or distinctive level of the monitored O_3 concentration. The event-related exceedance occurs during a time of year that typically has no exceedances, or is clearly distinguishable (*e.g.*, 5-10 parts per billion (ppb) higher) from non-event exceedances.
    - In these situations, O_3 impacts should be accompanied by clear evidence that the wildfire's emissions were transported to the location of the monitor.

- Tier 2: The wildfire event's O_3 influences are higher than non-event related concentrations, and fire emissions compared to the fire's distance from the affected monitor indicate a clear causal relationship.
    - *Key Factor 1*: fire emissions and distance of fire(s) to affected monitoring site location(s). Calculated fire emissions of nitrogen oxides (NO_x) and reactive-volatile organic compounds (VOC) in tons per day (Q) divided by the distance from the fire to the monitoring site (D) should be equal to or greater than 100 tons per day/kilometers ($Q/D \geq 100$ tpd/km). The guidance document provides additional information on the calculation of Q/D.

[4] "Guidance on the Preparation of Exceptional Events Demonstrations for Wildfire Events that May Influence Ozone Concentrations" (September 2016) ("wildfire O_3 guidance document").

- *Key Factor 2*: comparison of the event-related O_3 concentration with non-event related high O_3 concentrations. The exceedance due to the exceptional event:
  - is in the 99th or higher percentile of the 5-year distribution of O_3 monitoring data, OR
  - is one of the four highest O_3 concentrations within 1 year (among those concentrations that have not already been excluded under the Exceptional Events Rule, if any).
- In addition to the analysis required for Tier 1, the air agency should supply additional evidence to support the weight of evidence that emissions from the wildfire affected the monitored O_3 concentration.

- Tier 3: The wildfire does not fall into the specific scenarios (i.e., does not meet the key factors) that qualify for Tier 1 or Tier 2, but the clear causal relationship criterion can still be satisfied by a weight of evidence showing.
  - In addition to the analyses required for Tier 1 and Tier 2, an air agency may further support the clear causal relationship with additional evidence that the fire emissions caused the O_3 exceedance.

Not Reasonably Controllable or Preventable

The Exceptional Events Rule requires that air agencies establish that the event be both not reasonably controllable and not reasonably preventable at the time the event occurred. This requirement applies to both natural events and events caused by human activities; however, it is presumed that wildfires on wildland will satisfy both factors of the "not reasonably controllable or preventable" element unless evidence in the record clearly demonstrates otherwise.[5]

Natural Event

According to the CAA and the Exceptional Events Rule, an exceptional event must be "an event caused by human activity that is unlikely to recur at a particular location *or* a natural event" (emphasis added). The 2016 Exceptional Events Rule includes in the definition of wildfire that "[a] wildfire that predominantly occurs on wildland is a natural event." Once an agency provides evidence that a wildfire on wildland occurred and demonstrates that there is a clear causal relationship between the measurement under consideration and the event, the EPA expects minimal documentation to satisfy the "human activity that is unlikely to recur at a particular location or a natural event" element. The EPA will address wildfires on other lands on a case-by-case basis.

EPA REVIEW OF EXCEPTIONAL EVENTS DEMONSTRATION

On March 15, 2021, CARB submitted an Initial Notification of a potential Exceptional Event for multiple exceedances of the 2008 8-hour O_3 NAAQS that occurred at the Simi Valley monitoring

[5] A wildfire is defined in 40 CFR 50.1(n) as "any fire started by an unplanned ignition caused by lightning; volcanoes; other acts of nature; unauthorized activity; or accidental, human-caused actions, or a prescribed fire that has developed into a wildfire. A wildfire that predominantly occurs on wildland is a natural event." Wildland is defined in 40 CFR 50.1(o) as "an area in which human activity and development are essentially non-existent, except for roads, railroads, power lines, and similar transportation facilities. Structures, if any, are widely scattered."

site within Ventura County, California on October 2-4, 2020.[6] On December 8, 2021, CARB submitted an exceptional event demonstration for three exceedances of the 2008 8-hour O_3 NAAQS that occurred at Simi Valley monitoring site within Ventura County, California on October 2-4, 2020.[7]

Regulatory Significance

The EPA determined that data exclusion of certain exceedances referenced in the Initial Notification may have a regulatory significance for determining whether the Ventura County, CA Serious nonattainment area attained the 2008 O_3 NAAQS and worked with CARB to identify the relevant exceedances and monitoring site affected.[8] Table 1 summarizes the exceedances measured at the Simi Valley monitoring site in October 2020 that CARB included in the demonstration.

Table 1: 2008 8-hour O_3 NAAQS Exceedance Summary

Exceedance Date	Monitoring Site Name	AQS ID	2008 8-hour Avg. (ppm)
October 2, 2020	Simi Valley	06-111-2002	0.086
October 3, 2020	Simi Valley	06-111-2002	0.095
October 4, 2020	Simi Valley	06-111-2002	0.080

Narrative Conceptual Model

The demonstration submitted by CARB provided a narrative conceptual model in the "Overview/Introduction," "Background," and "Narrative Conceptual Model" sections of the demonstration to describe how emissions from multiple wildfires burning in Central and Southern California, most notably the Bobcat Fire, caused the O_3 exceedances at the Simi Valley monitoring site. The demonstration addressed the regulatory significance of the exceptional event in "Overview/Introduction" explaining that the exclusion of wildfire events in 2018 and 2020 would affect a determination of attainment for the Ventura County, CA Serious nonattainment area for the 2008 O_3 NAAQS.[9] The "Overview/Introduction" and "Background" chapters provided information to support the narrative conceptual model including characteristics of the nonattainment area, such as geography, topography, meteorology, the ambient O_3 monitoring network, typical non-event O_3 formation conditions and patterns, seasonal O_3 variations, and emissions of O_3 precursors.[10]

The narrative conceptual model described characteristics of the event. This included a summary of the occurrences of wildfires in California and specific descriptions of individual wildfires, such as the SQF Complex, Creek, and Bobcat fires, that generated smoke contributing to O_3 exceedances at the Simi Valley monitoring site on October 2-4, 2020.[11] The demonstration provided tables for the actively burning fires during the time of the exceedances which include the fire name, source, start date, containment date, location, and total acreage burned along with

[6] See email from Sylvia Vanderspek, CARB, to Gwen Yoshimura, EPA Region 9, dated March 15, 2021.
[7] See letter from Michael Benjamin, CARB, to Matthew Lakin, EPA Region 9, dated December 8, 2021.
[8] See letter from Elizabeth Adams, EPA Region 9, to Sylvia Vanderspek, CARB, dated April 21, 2021.
[9] See demonstration, pp. 2, 4-6.
[10] See demonstration pp. 10-17, 19-22.
[11] See demonstration pp. 23-26.

maps of the fire perimeters.[12] The narrative conceptual model also included figures displaying meteorological conditions on the dates of the fires and Hybrid Single Particle Lagrangian Integrated Trajectory (HYSPLIT) modeling results. The HYSPLIT trajectory modeling results were presented with satellite imagery, Hazard and Mapping System (HMS) satellite-derived smoke layers, and meteorological analysis to support that wildfire emissions were transported to the monitoring site in the South Central Coast Air Basin on the exceptional event dates requested for exclusion.[13] Along with these graphics, the narrative conceptual model included descriptions of how wildfire smoke from Central and Southern California were transported by the Santa Ana winds to the Simi Valley monitoring site with coastline offshore/onshore patterns contributing to the buildup of pollutants between October 2, 2020 and October 4, 2020.[14]

The narrative conceptual model included charts showing event related concentrations and long-term trends. The concentrations of 1-hour O_3 and particulate matter less than or equal to 2.5 microns in aerodynamic diameter ($PM_{2.5}$) were plotted from October 1, 2020 through October 6, 2020, at the Simi Valley monitoring site.[15] Although some of the highest $PM_{2.5}$ peaks for the requested dates occurred during the nighttime when O_3 concentrations generally taper off due to the lack of photochemical activity, $PM_{2.5}$ concentrations still remained elevated during each day of O_3 exceedances, indicating that wildfire smoke impacted O_3 and $PM_{2.5}$ concentrations measured at the Simi Valley monitoring site.[16] The demonstration also included a chart of 8-hour O_3 design values at the monitoring site from 2009 to 2020 suggesting that the Simi Valley design values have been trending towards attainment of the 2008 O_3 NAAQS. Furthermore, the demonstration noted that the area's 8-hour O_3 design values would meet the 2008 O_3 NAAQS for the year 2020 if the exceptional events requested in the demonstration are excluded.[17]

The narrative conceptual model also included daily meteorological data, specifically, temperatures and wind speeds along with 1-hour and 8-hour O_3 concentrations from the Simi Valley monitoring site for September 30, 2020 to October 6, 2020. The discussion examined temperature and wind speeds between September 30, 2020 and October 6, 2020, and indicated that the meteorological conditions observed at the monitoring site on the requested exceptional event days were not more favorable for high O_3 formation, as similar meteorological conditions were observed on non-event days that experienced much lower O_3 concentrations.[18] The demonstration concluded that O_3 directly related to wildfire smoke influenced the exceedances rather than unusual weather.[19]

The narrative conceptual model also included an air quality advisory issued by Ventura County Air Pollution Control District (APCD) for October 3-5, 2020 describing unhealthy air

[12] See demonstration pp. 27-66.
[13] See demonstration, pp. 82-83, 94, 96; Appendix D, pp. 188-238, 242-245.
[14] See demonstration, p. 80.
[15] See demonstration, pp. 90-91.
[16] Cross reference 95th percentile $PM_{2.5}$ trendlines in Figures IV-27 and IV-29 as supporting evidence of the persistent abnormally high concentrations, pp. 130-131.
[17] See demonstration, p. 92.
[18] See demonstration pp. 96-97.
[19] See demonstration pp. 93-97.

quality due to wildfire smoke throughout Ventura County, as well as examples of media coverage of the 2020 wildfires in Southern California.[20]

Overall, the demonstration contained the elements required for inclusion in the conceptual model portion of the exceptional events demonstration.

Table 2: Documentation of the Narrative Conceptual Model

Exceedance Date	Demonstration Citation	Quality of Evidence	Criterion Met?
October 2-4, 2020	"Overview/Introduction": pp. 2-6 "Background": pp. 10-16, 19-22 "Narrative Conceptual Model": pp. 23-69, 78-83, 89-101 Appendix B-2: pp.156-158 Appendix D: pp. 188-238, 242-245 Appendix F-1: pp. 269-272	Sufficient	Yes

Clear Causal Relationship

The demonstration included several analyses to support a clear causal relationship between the wildfire event and the monitored exceedances. These analyses were presented in the "Clear Causal Relationship" section of the demonstration.

Comparison with historical concentrations

The demonstration included a comparison with historical concentrations, as required by 40 CFR §50.14(c)(3)(iv)(C). The demonstration compared O_3 concentrations at the Simi Valley monitoring site on the 2020 wildfire exceptional event days to historical non-event O_3 concentrations from 2015-2020.[21] This included a graph of daily maximum 8-hour average concentrations over the six-year period by day of the year, along with the level of the NAAQS and the 99th percentile value at the site. In Figure IV-2, the O_3 concentrations at the Simi Valley monitoring site on October 2-4, 2020 were shown to be above the 99th percentile value of 0.076 ppm. However, O_3 concentrations were not clearly distinguishable (at least 0.005 ppm higher) from non-event exceedances and elevated O_3 concentrations are not uncommon at this time of the year.

Tier 1: Key Factor

To meet the key factor for a Tier 1 analysis, exceedances should be clearly higher than other non-event related exceedances or occur during a time of year that typically experiences no exceedances. The exceedances identified in this demonstration occurred during a season when exceedances at the Simi Valley monitoring site have historically been observed. While the exceedances on October 2-4, 2020 are above the 99th percentile of O_3 concentrations measured from 2015-2020, they do not exceed non-event exceedance concentrations of the last five years by at least 5 ppb.[22] Therefore, the exceedances do not meet the Tier 1 Key Factor and additional evidence beyond a Tier 1 analysis is needed to support the clear causal relationship.

[20] See demonstration, Appendix B, p. 158; Appendix F, pp. 269-272.
[21] See demonstration, p. 105.
[22] See demonstration, pp. 102-103, 105.

Tier 2: Key Factors

The demonstration included an evaluation of the Tier 2 Key Factors. For Tier 2 Key Factor 1, the demonstration provided an analysis of fire emissions (Q) and distance (D) of the wildfires to the monitoring site locations. The Q/D value is generally calculated by dividing wildfire emissions (in tpd) by the distance between the wildfire and the monitoring site (in kilometers [km]). Daily Q/D values were calculated by the EPA using daily wildland fire emissions input files originally created for the Community Multiscale Air Quality (CMAQ) modeling system. The resulting calculations were shared with CARB to assist in demonstration development. CMAQ input files included the associated fire's daily emissions of nitrogen oxide (NO), nitrogen dioxide (NO_2), and reactive organic gases (ROG) at release points corresponding to wildfire locations. Q/D was calculated for each CMAQ input release point by calculating the distance between release point locations and gridded receptor locations and dividing the total emissions by this distance. An aggregated daily Q/D was then calculated by summing the individual Q/D values for each release point. An "effective Q/D" value was calculated at monitoring site receptor locations by accounting for periods where multiple days of wildfire smoke buildup impacted the monitoring site for up to three total days; the dates to include in each daily "effective Q/D" were based on meteorology and transport analyses, with the rationale further outlined in the demonstration.[23] The distance-weighted sums for October 2-4, 2020 are 28, 24, and 38 tpd/km respectively, which are below the Tier 2 Key Factor 1 screening value of 100 tons per day of NO_x and VOC per km.[24] Therefore, the event exceedances do not meet Tier 2 Key Factor 1.

For Tier 2 Key Factor 2, the demonstration included evidence that the exceedances are at or above the 99th percentile from the past five years of O_3 season data (2015-2019) or among the four highest concentrations measured at the site in 2020. In the demonstration, CARB determined an "adjusted 4th high" corresponding to the 4th highest non-event exceedance monitored in 2020, excluding the exceedances for which CARB submitted an exceptional events demonstration.[25] CARB stated that dates impacted by exceptional events should not count against the tally of the four highest O_3 concentrations measured in 2020 because these exceedances were caused by contributions from wildfire emissions.[26] This rationale is supported given that the purpose of the test is to show that the exceedances are high compared to non-event data. Since the excluded dates are all included in the demonstration being evaluated for the Ventura County, CA Serious nonattainment area, each individual date would not count towards the four highest concentrations if concurred on by the EPA.[27] As shown in Table IV-4 of the demonstration, the monitored O_3 concentrations on all dates requested as exceptional events exceed the adjusted 4th high O_3 concentration at the Simi Valley monitoring site in 2020.[28] Therefore, the event exceedances meet Tier 2 Key Factor 2.

Based on the analysis of the Key Factors for Tier 2, the EPA's wildfire O_3 guidance document indicates that a Tier 3 analysis is appropriate for this event. As described below, the demonstration included the required elements for a clear causal relationship analysis based on

[23] See demonstration, pp. 106-107.
[24] See demonstration, pp. 110-111.
[25] See demonstration, pp. 111-113.
[26] See demonstration, p. 111.
[27] This demonstration also includes analyses for exceptional event dates that occurred at the Simi Valley monitoring site on August 18, 2020 and August 21, 2020. These exceptional event dates are evaluated by the EPA in separate TSDs.
[28] See demonstration, pp. 112-113.

the EPA's wildfire O_3 guidance document. This includes evidence to support that (1) wildfire emissions were transported from the wildfire to the monitor;(2) wildfire emissions affected the monitor; and (3) wildfire emissions caused the O_3 exceedances.

Tier 3 analysis: Evidence of transport of wildfire emissions from the wildfire to the monitor
The demonstration presented analyses in the "Narrative Conceptual Model" and Appendix D using backward trajectory and forward trajectory modeling.[29] HYSPLIT back trajectories originating at the monitor location at three elevations (1000 meters (m), 500m, and 100m) show the likely path of air parcels during the event period, 36 hours prior to the first hour of the exceeding 8-hour time period and 36 hours prior to the hour of maximum concentrations within that 8-hour time period; Figure III-31 overlays one set of these back trajectories on National Oceanic and Atmospheric Administration (NOAA) HMS Fire and Smoke Product imagery. HYSPLIT forward trajectories beginning at the wildfire locations at the same three elevations show the most likely center path air parcels travelled for 36 to 48 hours, starting at 4:00 PM PST the day before the exceedances and at 4:00 AM PST the day of the exceedances; Figure III-30 overlays one set of these forward trajectories on satellite imagery to provide a visual analysis of whether smoke emitted from the fires may have impacted ambient O_3 concentrations at the Simi Valley monitoring site.

The forward trajectories (Figure III-30), shown for October 2, 2020, depict trajectories which leave numerous wildfires in southern and central California and move southeast towards Simi Valley and off the coast west of Simi Valley. Appendix D provides additional forward trajectories for fires active during this time period and indicate air parcels moving toward Simi Valley.[30] The backward trajectories (Figure III-31), shown for October 2, 2020, depict 100m and 500m trajectories coming from the north where high smoke concentration are depicted on the HMS map. The 1000m backward trajectory for October 2, 2020 is from areas in eastern California for which HMS does not appear to show any smoke. Therefore, the two trajectories closest to ground level show transport to the Simi Valley monitor location from high smoke areas.[31] For October 3 and October 4, 2020, backward trajectories are shown in Appendix D-2.[32] For October 3, 2020, the backward trajectories from the Simi Valley monitoring site depict transport at 100 m and 500 m which originate from central and southern California, areas heavily affect by wildfires. For October 4, 2020, the trajectories provide evidence of air parcel transport from central and southern California, as well as from offshore particularly later in the afternoon. Lastly, Terra Moderate Resolution Imaging Spectroradiometer (MODIS) imagery indicated that convergent smoke from several fires was transported from the San Joaquin Valley and caused light visible smoke conditions on October 3, 2020. By October 3, 2020, heavier smoke from the Bobcat Fire to the west of Simi Valley became the primary contributor.[33] The backward and forward trajectory analyses support that the wildfire emissions were transported to the monitoring site on the days requested for exclusion as exceptional events.

[29] See demonstration, pp. 82-83, Appendix D, pp. 225-238, 244-245.
[30] See demonstration, p. 82, Appendix D, pp. 225-238.
[31] See demonstration, p. 83.[32] See demonstration, Appendix D, pp. 244-245.
[32] See demonstration, Appendix D, pp. 244-245.
[33] See demonstration, p. 81.

Tier 3 analysis: Evidence that the wildfire emissions affected the monitor

The demonstration provided evidence in the "Narrative Conceptual Model" and "Clear Causal Relationship" chapters of wildfire emissions affecting the Simi Valley monitoring site, including analysis of daily O_3 and $PM_{2.5}$ concentrations and 1-hour O_3 diurnal patterns. The demonstration included figures comparing the daily diurnal pattern of 1-hour O_3 concentrations on October 2-4, 2020 to hourly diurnal O_3 percentiles from 2015-2019, which included the 5th, 50th, and 95th percentile values.[34] Figure IV-11 through Figure IV-13 indicate that each morning around 6:00 AM PST to 9:00 AM PST, concentrations rose from approximately the 50th percentile of the historical concentration profile to nearly the 95th percentile. After 9:00 AM PST, O_3 concentrations continued to rise until peaking at approximately 1:00 PM PST each day. The peak hourly concentrations for October 2-4, 2020 were approximately 0.099 ppm, 0.104 ppm, and 0.093 ppm, respectively. Concentrations remained above the 95th percentile on all three days until 5:00 PM or 6:00 PM PST. These diurnal O_3 profiles show that 1-hour O_3 concentrations peak well above the 95th percentile of historical concentrations measured between 2015-2019 on each day. Moreover, on October 2, 2020 and October 3, 2020, the diurnal profiles deviated from the norm, with concentrations sharply increasing again around 8:00 PM and 9:00 PM PST rather than continuing to decrease through the end of the day.

The demonstration also provided seasonal 1-hour $PM_{2.5}$ concentrations for October 2015-2019 compared with the 1-hour $PM_{2.5}$ concentrations for October 2-4, 2020 measured at the Simi Valley monitoring site (Figures IV-27 – IV-29).[35] Historical seasonal 1-hour $PM_{2.5}$ diurnal patterns show concentrations are generally consistent throughout the day (between 5 to 9 $\mu g/m^3$ for all hours for the 50th percentile; around 16 to 18 $\mu g/m^3$ for the 95th percentile) with a moderate peak (around 25 $\mu g/m^3$) between 6:00 AM PST to 8:00 AM PST in the 95th percentile diurnal pattern. The daily diurnal 1-hour $PM_{2.5}$ concentrations on October 2, 2020 through October 4, 2020 deviate from the norm, with concentrations generally well above the 95th percentile, and peaks outside the expected hours. The $PM_{2.5}$ concentration exceeded the 95th percentile beginning on October 2, 2020 at approximately 10:00 AM PST and remained above the 95th percentile for almost all hours through the end of October 4, 2020. The maximum $PM_{2.5}$ concentration occurred at approximately 3:00 AM PST on October 3, 2020 at a value around 51 $\mu g/m^3$. The trend in 1-hour $PM_{2.5}$ concentrations is consistent with the timing of the wildfire and meteorological events described in the "Narrative Conceptual Model" chapter of this demonstration and supports that wildfire emissions were affecting air quality at the Simi Valley monitoring site.

Additionally, the demonstration provided evidence that the wildfire emissions affected the monitoring using data obtained through non-regulatory monitoring at Port Hueneme, which is approximately 30 miles west-southwest of the Simi Valley monitoring site. At Port Hueneme, PM and black carbon concentrations were elevated from October 1 through early October 4, 2020 (Figure IV-33), which strongly suggests the presence of wildfire smoke at ground level in areas near Simi Valley. In addition to being elevated, the difference in signal between the two aethalometer channels (the black carbon channel and the wood smoke channel) during this time

[34] See demonstration, pp. 119-120.
[35] See demonstration, pp. 130-131.

period provides strong support that the elevated levels of $PM_{2.5}$ and black carbon observed in the area were due to wildfire smoke.[36]

The O_3 hourly concentration and percentile profile analysis, $PM_{2.5}$ hourly concentration and percentile profile analysis, and black carbon analysis support that wildfire emissions reached the ground and affected measurements at the Simi Valley monitoring site on October 2-4, 2020.

Tier 3 analysis: Additional evidence that the wildfire emissions caused the O_3 exceedance
The demonstration included additional evidence to support that the wildfire emissions specifically affected O_3 concentrations at the exceeding Simi Valley monitoring site and caused the O_3 exceedances. The demonstration included an analysis of coincident increases in O_3 and $PM_{2.5}$, National Weather Service (NWS) area forecast discussions, and Navy Aerosol Analysis and Prediction System (NAAPS) modeling.

The last graph presented as part of Figure III-36 shows the 1-hour O_3 and 1-hour $PM_{2.5}$ concentrations measured at the Simi Valley monitoring site from September 30, 2020 to October 7, 2020. The demonstration concluded that the consistent relationship between high $PM_{2.5}$ concentrations and elevated O_3 across the event period supports a strong wildfire smoke influence at the monitor. These high concentrations of O_3 and $PM_{2.5}$ starting around October 2 through October 4, 2020 provide additional supporting evidence that the exceedances were caused by wildfire emissions.[37]

As additional evidence to support that wildfire emissions affected the Simi Valley monitoring site, the demonstration included air quality alerts issued by Ventura County APCD for October 3-5, 2020, weather statements issued by the NWS Los Angeles/Oxnard office from October 1-4, 2020, and the NAAPS Global Aerosol Model.[38] The Ventura County APCD air quality alert issued on October 3, 2020 indicated that calm winds over the night had allowed smoke concentrations to remain elevated and that excessive smoke concentrations could persist through October 5, 2020. The NWS mentioned that thin smoke layers would be present throughout the general region, which included Ventura County, throughout the requested exceedance dates. Results from the NAAPS Global Aerosol Model were also presented to show a predicted increase in particulate matter in the atmosphere. The NAAPS outputs include a Smoke Surface Concentration map which simulates elevated smoke concentrations at the surface for much of California, including the Ventura County area, for October 2-4, 2020.

Overall, the elevated $PM_{2.5}$ and O_3 concentrations during the event period, special weather statements, air quality alerts, and NAAPS modeling results help support that wildfire emissions from the wildfires burning throughout California caused the O_3 exceedances observed on October 2-4, 2020.

Conclusion
The analyses included in the demonstration, specifically, temporal ambient O_3 and $PM_{2.5}$ monitoring data, Q/D analyses, HYSPLIT backward and forward trajectory analyses, NOAA HMS fire and smoke product imagery, NASA's Terra MODIS satellite imagery, paired

[36] See demonstration, pp. 131-135.
[37] See demonstration, pp. 90-91.
[38] See demonstration, Appendix B-2, p. 158; Appendix C-2, pp. 181-187; Appendix E-2, pp. 256-259.

PM and black carbon analyses from non-regulatory ambient monitoring, NWS special weather statements, and NAAPS Global Aerosol Model, sufficiently demonstrate a clear causal relationship between the emissions generated by several wildfires burning and central and southern California, most notably the Bobcat Fire, and the exceedances measured at the Simi Valley monitoring site.

Table 3: Documentation of the Clear Causal Relationship criterion

Exceedance Date	Demonstration Citation	Quality of Evidence	Criterion Met?
October 2-4, 2020	"Narrative Conceptual Model": pp. 78-83 "Clear Causal Relationship": pp. 90-122, 130-131, 135, 139 Appendix B: p. 158 Appendix C: pp. 181-187 Appendix D: pp. 188-238, 244-245 Appendix E: pp. 257-259 Appendix F: pp. 269-272	Sufficient	Yes

Not Reasonably Controllable or Preventable

The Exceptional Events Rule presumes that wildfire events on wildland are not reasonably controllable or preventable [40 CFR §50.14(b)(4)]. The demonstration provided evidence that the wildfire event meets definition of wildfire [40 CFR §50.1(n)]. Specifically, the demonstration included maps and descriptions of the wildfires, along with figures showing wildfire boundaries overlaid upon land ownership and wildland-urban interface layers to demonstrate that the fires occurred on wildland or in the urban/wildland interface.[39] The demonstration described that CARB is not aware of any evidence clearly demonstrating that prevention or control efforts beyond those actually made would have been reasonable.[40] Therefore, the documentation provided sufficiently demonstrates that the event was not reasonably controllable and not reasonably preventable.

Table 4: Documentation of the Not Reasonably Controllable or Preventable criterion

Exceedance Date	Demonstration Citation	Quality of Evidence	Criterion Met?
October 2-4, 2020	"Narrative Conceptual Model"*:* pp. 25-68 "Not reasonably Controllable and/or Not Reasonably Preventable*":* p. 140	Sufficient	Yes

Natural Event

The definition of "wildfire" at 40 CFR §50.1(n) states, "A wildfire that predominantly occurs on wildland is a natural event." As previously described, the demonstration included documentation that the event meets the definition of a wildfire and occurred predominantly on wildland and has therefore shown that the event was a natural event.

[39] See demonstration, pp. 67-68.
[40] See demonstration, p. 140.

Table 5: Documentation of the Natural Event criterion

Exceedance Date	Demonstration Citation	Quality of Evidence	Criterion Met?
October 2-4, 2020	"Narrative Conceptual Model"*:* pp 67-68 "Natural Event/Human Activity Unlikely to Recur": p. 140	Sufficient	Yes

Schedule and Procedural Requirements

In addition to technical demonstration requirements, 40 CFR §50.14(c) and 40 CFR §51.930 specify schedule and procedural requirements an air agency must follow to request data exclusion. Table 6 outlines the EPA's evaluation of these requirements.

Table 6: Schedules and Procedural Criteria

	Reference	Demonstration Citation	Criterion Met?
Did the agency provide prompt public notification of the event?	40 CFR §50.14 (c)(1)(i)	"Narrative Conceptual Model": pp. 97-99 "Public Notification": p. 140; Appendix B-2 p. 159	Yes
Did the agency submit an Initial Notification of Potential Exceptional Event and flag the affected data in the EPA's Air Quality System (AQS)?	40 CFR §50.14 (c)(2)(i)	Appendix A-2: p. 152-153	Yes
Did the initial notification and demonstration submittals meet the deadlines for data influenced by exceptional events for use in initial area designations, if applicable? Or the deadlines established by the EPA during the Initial Notification of Potential Exceptional Events process, if applicable?	40 CFR §50.14 Table 2 40 CFR §50.14 (c)(2)(i)(B)	See email from Sylvia Vanderspek, CARB, to Gwen Yoshimura, EPA Region 9, dated March 15, 2021	Yes
Was the public comment process followed and documented? • Did the agency document that the comment period was open for a minimum of 30 days? • Did the agency submit to the EPA any public comments received? • Did the state address comments disputing or contradicting factual evidence provided in the demonstration?	40 CFR §50.14 (c)(3)(v)	"Public Notification": p. 140; See letter from Michael Benjamin, CARB, to Matthew Lakin, dated December 8, 2021	Yes
Has the agency met requirements regarding submission of a mitigation plan, if applicable?	40 CFR §51.930 (b)	NA	NA

Conclusion

The EPA has reviewed the documentation provided by CARB to support claims that smoke from several large wildfires in Southern and Central California, most notably the Bobcat Fire, caused exceedances of the 2008 8-hour O_3 NAAQS at the Simi Valley monitoring site on October 2- 4, 2020. The EPA has determined that the flagged exceedances at this monitoring site on these days satisfy the exceptional event criteria: the event was a natural event, which affected air quality in such a way that there exists a clear causal relationship between the event and the monitored exceedance and was not reasonably controllable or preventable. The EPA has also determined that CARB has satisfied the schedule and procedural requirements for data exclusion.

ENCLOSURE: TECHNICAL SUPPORT DOCUMENT FOR EPA CONCURRENCE ON O_3 EXCEEDANCES MEASURED IN CALAVERAS COUNTY, CA ON JULY 28, JULY 30-31, AUGUST 2, AUGUST 5, AUGUST 8-10, 2018 AS AN EXCEPTIONAL EVENT

On September 17, 2021, the California Air Resources Board (CARB) submitted an exceptional event demonstration for exceedances of the 2015 8-hour ozone (O_3) National Ambient Air Quality Standards (NAAQS) of 0.070 parts per million (ppm) that occurred at the San Andreas monitoring site on July 28, July 30-31, August 2, August 5, and August 8-10, 2018.[1] The demonstration submitted by CARB stated that the exceedances measured at the San Andreas monitoring site between July 26 and August 10, 2018 were caused by multiple wildfires burning in Northern and Central California and Southern Oregon, namely the Ranch, River, Carr, Donnell, and Ferguson fires.[2] Under the Exceptional Events Rule, air agencies can request the exclusion of event-influenced data, and the EPA can agree to exclude these data, from the data set used for certain regulatory decisions. The remainder of this document summarizes the Exceptional Events Rule requirements, the event and the EPA's review process.

EXCEPTIONAL EVENTS RULE REQUIREMENTS

The EPA promulgated the Exceptional Events Rule in 2007, pursuant to the 2005 amendment of Clean Air Act (CAA) Section 319. In 2016, the EPA finalized revisions to the Exceptional Events Rule. The 2007 Exceptional Events Rule and 2016 Exceptional Events Rule revisions added sections 40 CFR §50.1(j)-(r); §50.14; and §51.930 to title 40 of the Code of Federal Regulations (CFR). These sections contain definitions, criteria for EPA approval, procedural requirements, and requirements for air agency demonstrations. The EPA reviews the information and analyses in the air agency's demonstration package using a weight of evidence approach and decides to concur or not concur. The demonstration must satisfy all of the Exceptional Events Rule criteria for the EPA to concur with excluding the air quality data from regulatory decisions.

Under 40 CFR §50.14(c)(3)(iv), the air agency demonstration to justify exclusion of data must include:

A. "A narrative conceptual model that describes the event(s) causing the exceedance or violation and a discussion of how emissions from the event(s) led to the exceedance or violation at the affected monitor(s);"

B. "A demonstration that the event affected air quality in such a way that there exists a clear causal relationship between the specific event and the monitored exceedance or violation;"

C. "Analyses comparing the claimed event-influenced concentration(s) to concentrations at the same monitoring site at other times" to support requirement (B) above;

[1] "Exceptional Events Demonstration for Ozone Exceedances; Northern California; July-August 2018 Wildfire Events", (September 17, 2021) ("demonstration"). The demonstration addresses multiple events and exceedances measured in Northern California in July – August 2018. The EPA's evaluation of the information presented in the demonstration is reflected in seven separate TSDs, grouped by nonattainment area affected.

[2] See demonstration, p. 62.

D. "A demonstration that the event was both not reasonably controllable and not reasonably preventable;" and

E. "A demonstration that the event was a human activity that is unlikely to recur at a particular location or was a natural event."[3]

In addition, the air agency must meet several procedural requirements, including:

1. submission of an Initial Notification of Potential Exceptional Event and flagging of the affected data in the EPA's Air Quality System (AQS) as described in 40 CFR §50.14(c)(2)(i),

2. completion and documentation of the public comment process described in 40 CFR §50.14(c)(3)(v), and

3. implementation of any relevant mitigation requirements as described in 40 CFR §51.930.

For data influenced by exceptional events to be excluded from use in initial area designations, air agencies must also meet the initial notification and demonstration submission deadlines specified in Table 2 to 40 CFR §50.14. We include below a summary of the Exceptional Events Rule criteria, including those identified in 40 CFR §50.14(c)(3)(iv).

Regulatory Significance

The 2016 Exceptional Events Rule includes regulatory language that applies the provisions of CAA section 319 to a specific set of regulatory actions. As identified in 40 CFR §50.14(a)(1)(i), these regulatory actions include initial area designations and redesignations; area classifications; attainment determinations (including clean data determinations); attainment date extensions; findings of State Implementation Plan (SIP) inadequacy leading to a SIP call; and other actions on a case-by-case basis as determined by the Administrator. Air agencies and the EPA should discuss the regulatory significance of an exceptional events demonstration during the Initial Notification of Potential Exceptional Event prior to the air agency submitting a demonstration for the EPA's review.

Narrative Conceptual Model

The 2016 Exceptional Events Rule directs air agencies to submit, as part of the demonstration, a narrative conceptual model of the event that describes and summarizes the event in question and provides context for analyzing the required statutory and regulatory technical criteria. Air agencies may support the narrative conceptual model with summary tables or maps. For wildfire O_3 events, the EPA recommends that the narrative conceptual model also discuss the interaction of emissions, meteorology, and chemistry of event and non-event O_3 formation in the area, and,

[3] A natural event is further described in 40 CFR 50.1(k) as "an event and its resulting emissions, which may recur at the same location, in which human activity plays little or no direct causal role. For purposes of the definition of a natural event, anthropogenic sources that are reasonably controlled shall be considered to not play a direct role in causing emissions."

under 40 CFR §50.14(a)(1)(i), must describe the regulatory significance of the proposed data exclusion.

Clear Causal Relationship and Supporting Analyses

The EPA considers a variety of evidence when evaluating whether there is a clear causal relationship between a specific event and the monitored exceedance or violation. For wildfire O_3 events, air agencies should compare the O_3 data requested for exclusion with seasonal and annual historical concentrations at the air quality monitor to establish a clear causal relationship between the event and monitored data. In addition to providing this information on the historical context for the event-influenced data, air agencies should further support the clear causal relationship criterion by demonstrating that the wildfire's emissions were transported to the monitor, that the emissions from the wildfire influenced the monitored concentrations, and, in some cases, air agencies may need to provide evidence of the contribution of the wildfire's emissions to the monitored O_3 exceedance or violation.

For wildfire O_3 events, the EPA has published a guidance document that provides three different tiers of analyses that apply to the "clear causal relationship" criterion within an air agency's exceptional events demonstration.[4] This tiered approach recognizes that some wildfire events may be more clear and/or extreme and, therefore, require relatively less evidence to satisfy the rule requirements. If a wildfire/O_3 event satisfies the key factors for either Tier 1 or Tier 2 clear causal analyses, then those analyses are the only analyses required to support the clear causal relationship criterion within an air agency's demonstration for that particular event. Other wildfire/O_3 events will be considered based on Tier 3 analyses.

- Tier 1: Wildfires that clearly influence monitored O_3 exceedances or violations when they occur in an area that typically experiences lower O_3 concentrations.
    - *Key Factor*: seasonality and/or distinctive level of the monitored O_3 concentration. The event-related exceedance occurs during a time of year that typically has no exceedances, or is clearly distinguishable (*e.g.*, 5-10 parts per billion (ppb) higher) from non-event exceedances.
    - In these situations, O_3 impacts should be accompanied by clear evidence that the wildfire's emissions were transported to the location of the monitor.

- Tier 2: The wildfire event's O_3 influences are higher than non-event related concentrations, and fire emissions compared to the fire's distance from the affected monitor indicate a clear causal relationship.
    - *Key Factor 1*: fire emissions and distance of fire(s) to affected monitoring site location(s). Calculated fire emissions of nitrogen oxides (NO_x) and reactive-volatile organic compounds (VOC) in tons per day (Q) divided by the distance from the fire to the monitoring site (D) should be equal to or greater than 100 tons per day/kilometers ($Q/D \geq 100$ tpd/km). The guidance document provides additional information on the calculation of Q/D.

[4] "Guidance on the Preparation of Exceptional Events Demonstrations for Wildfire Events that May Influence Ozone Concentrations" (September 2016) ("wildfire O_3 guidance document").

- *Key Factor 2*: comparison of the event-related O_3 concentration with non-event related high O_3 concentrations. The exceedance due to the exceptional event:
  - is in the 99th or higher percentile of the 5-year distribution of O_3 monitoring data, OR
  - is one of the four highest O_3 concentrations within 1 year (among those concentrations that have not already been excluded under the Exceptional Events Rule, if any).
- In addition to the analysis required for Tier 1, the air agency should supply additional evidence to support the weight of evidence that emissions from the wildfire affected the monitored O_3 concentration.

- Tier 3: The wildfire does not fall into the specific scenarios (i.e., does not meet the key factors) that qualify for Tier 1 or Tier 2, but the clear causal relationship criterion can still be satisfied by a weight of evidence showing.
  - In addition to the analyses required for Tier 1 and Tier 2, an air agency may further support the clear causal relationship with additional evidence that the fire emissions caused the O_3 exceedance.

Not Reasonably Controllable or Preventable

The Exceptional Events Rule requires that air agencies establish that the event be both not reasonably controllable and not reasonably preventable at the time the event occurred. This requirement applies to both natural events and events caused by human activities; however, it is presumed that wildfires on wildland will satisfy both factors of the "not reasonably controllable or preventable" element unless evidence in the record clearly demonstrates otherwise.[5]

Natural Event

According to the CAA and the Exceptional Events Rule, an exceptional event must be "an event caused by human activity that is unlikely to recur at a particular location *or* a natural event" (emphasis added). The 2016 Exceptional Events Rule includes in the definition of wildfire that "[a] wildfire that predominantly occurs on wildland is a natural event." Once an agency provides evidence that a wildfire on wildland occurred and demonstrates that there is a clear causal relationship between the measurement under consideration and the event, the EPA expects minimal documentation to satisfy the "human activity that is unlikely to recur at a particular location or a natural event" element. The EPA will address wildfires on other lands on a case-by-case basis.

EPA REVIEW OF EXCEPTIONAL EVENTS DEMONSTRATION

On March 16, 2021, CARB submitted an Initial Notification of a potential Exceptional Event for multiple exceedances of the 2015 8-hour O_3 NAAQS that occurred at the San Andreas

[5] A wildfire is defined in 40 CFR 50.1(n) as "any fire started by an unplanned ignition caused by lightning; volcanoes; other acts of nature; unauthorized activity; or accidental, human-caused actions, or a prescribed fire that has developed into a wildfire. A wildfire that predominantly occurs on wildland is a natural event." Wildland is defined in 40 CFR 50.1(o) as "an area in which human activity and development are essentially non-existent, except for roads, railroads, power lines, and similar transportation facilities. Structures, if any, are widely scattered."

monitoring site within Calaveras County between July 28 and August 10, 2018.[6] On September 17, 2021, CARB submitted an exceptional event demonstration for eight exceedances of the 2015 8-hour O_3 NAAQS that occurred at the San Andreas monitoring site within Calaveras County on July 28, July 30-31, August 2, August 5, and August 8-10 of 2018.[7]

Regulatory Significance

The EPA determined that data exclusion of the exceedances referenced in the Initial Notification may have a regulatory significance for the determination of attainment by the August 3, 2021 attainment date for the Calavaras County, California nonattainment area for the 2015 O_3 NAAQS, and worked with CARB to identify the relevant exceedances and monitoring sites affected.[8] Table 1 summarizes the exceedances measured at the San Andreas monitoring site that CARB included in the demonstration.

Table 1: 2015 8-hour O_3 NAAQS Exceedance Summary

Exceedance Date	Monitoring Site Name	AQS ID	8-hour Avg. (ppm)
July 28, 2018	San Andreas	06-009-001	0.071
July 30, 2018	San Andreas	06-009-001	0.077
July 31, 2018	San Andreas	06-009-001	0.086
August 2, 2018	San Andreas	06-009-001	0.074
August 5, 2018	San Andreas	06-009-001	0.078
August 8, 2018	San Andreas	06-009-001	0.071
August 9, 2018	San Andreas	06-009-001	0.081
August 10, 2018	San Andreas	06-009-001	0.076

Narrative Conceptual Model

The demonstration submitted by CARB provided a narrative conceptual model in the sections of the demonstration titled "Overview/Introduction," "Background," and "Narrative Conceptual Model – July 26-August 10, 2018" to describe how emissions from wildfires in Northern and Central California and Southern Oregon caused the O_3 exceedances at the San Andreas monitoring site.

The Overview/Introduction and Background sections of the demonstration provided information supporting the narrative conceptual model including characteristics of the nonattainment area, such as geography, topography, meteorology, typical non-event O_3 formation conditions and patterns, seasonal O_3 variations, the ambient O_3 monitoring network, and emissions of O_3 precursors.[9]

The narrative conceptual model described characteristics of the event. This included a general description of the occurrence of wildfires in Northern and Central California and Southern Oregon, and specific descriptions of major wildfires active between July 26 and August 10, 2018, including the name, cause, start date, containment date, location, and total acreage burned

[6] See email from Sylvia Vanderspek, CARB, to Gwen Yoshimura, EPA Region 9, dated March 16, 2021.
[7] See letter from Michael Benjamin, CARB, to Elizabeth Adams, EPA Region 9, dated September 17, 2021.
[8] See letter from Elizabeth Adams, EPA Region 9, to Sylvia Vanderspek, CARB, dated April 21, 2021.
[9] See demonstration, pp. 10-12, 17-19, 20.

for each fire.[10] The narrative conceptual model also included figures displaying meteorological conditions on the dates of the fires and Hybrid Single Particle Lagrangian Integrated Trajectory (HYSPLIT) modeling results. The HYSPLIT trajectory modeling results were presented with satellite imagery, Hazard and Mapping System (HMS) satellite-derived smoke layers, and meteorological analyses to support that wildfire emissions were transported to the San Andreas monitoring site on the exceptional event dates requested for exclusion. Along with these graphics, the narrative conceptual model included narrative descriptions of how meteorological conditions affected the behavior of air and smoke in the areas of the wildfires on July 26-29, July 30-31, August 1-2, August 6-9, and August 10-11 of 2018.[11]

The narrative conceptual model included charts showing the concentrations of O_3 and particulate matter less than or equal to 2.5 microns in aerodynamic diameter ($PM_{2.5}$) between July 15 and August 15, 2018 at the San Andreas monitoring site and suggested that elevated $PM_{2.5}$ concentrations coinciding with the timing of the wildfires and elevated O_3 concentrations support the presence of wildfire smoke in the town of San Andreas.[12] The narrative conceptual model also included charts of 8-hour O_3 design values and annual fourth high 8-hour average O_3 concentrations at the San Andreas monitoring site and suggested that the 2018 O_3 design value strayed from trends in recent years.[13] The narrative conceptual model addressed the regulatory significance of the exceptional events by noting that the exclusion of the wildfire events in 2018 would affect a determination of attainment for the Calaveras County, California Marginal nonattainment area for the 2015 O_3 NAAQS.[14]

Tables 3-15 and 3-16 in the "Narrative Conceptual Model" chapter of the demonstration showed the averages and standard deviations of temperatures and wind speeds at the San Andreas monitor for July 2018 to August 2018.[15] Table 3-17 showed the 1-hour and 8-hour average O_3 concentrations, maximum daily temperature, and maximum daily wind speed at the San Andreas monitor on each exceptional event day.[16] Maximum daily temperatures and wind speeds at the San Andreas monitor on the exceedance days were primarily above 90 degrees Fahrenheit and in the range of seven to nine miles per hour, similar to non-event days in July 2018 and August 2018. The demonstration concluded that weather patterns observed at the San Andreas monitor on exceptional event days were not more favorable for O_3 formation than on non-event days and that O_3 directly related to wildfire smoke influenced the exceedances as opposed to unusual weather.

The narrative conceptual model described the wildfire smoke information and emergency notification programs utilized by the Calaveras County Air Pollution Control District (APCD), including the use of Facebook and Twitter to notify the public regarding wildfire smoke.[17] Appendix II of the demonstration included public service announcements issued by Calaveras County APCD reporting smoke impacting air quality on July 18, July 30, August 3, and August

[10] See demonstration, pp. 27-40.
[11] See demonstration, pp. 40-61.
[12] See demonstration, p. 62.
[13] See demonstration pp. 62-63.
[14] See demonstration, pp. 2, 4.
[15] See demonstration, p. 74.
[16] See demonstration, p. 75.
[17] See demonstration, p. 79.

9 in 2018. The demonstration also included examples of social media coverage of the 2018 wildfires in Northern and Central California describing thick blankets of smoke.[18]

Overall, the demonstration contained the elements required for inclusion in the conceptual model portion of the exceptional events demonstration.

Table 2: Documentation of the Narrative Conceptual Model

Exceedance Dates	Demonstration Citation	Quality of Evidence	Criterion Met?
July 28, 30-31, August 2, August 5, August 8-10, 2018	"Overview/Introduction": pp. 1-9 "Background": pp. 10-26 "Narrative Conceptual Model – July 26-August 10, 2018": pp. 27-82 Appendix II: pp. 168-172	Sufficient	Yes

Clear Causal Relationship

The demonstration included several analyses to support a clear causal relationship between the wildfire event and the monitored exceedances. These analyses are presented in the "Clear Causal Relationship" section of the demonstration.

Comparison with historical concentrations

The demonstration included a comparison with historical concentrations, as required by 40 CFR §50.14(c)(3)(iv)(C). The demonstration compared O_3 concentrations at the San Andreas monitoring site on the 2018 wildfire exceptional event days to historical non-event O_3 concentrations between 2013 and 2018. This included a graph of daily maximum 8-hour average O_3 concentrations over the six-year period by day of year along with the level of the NAAQS and the 99th percentile value at the site. The demonstration noted that the exceptional events occurred during the time of year when O_3 concentrations tend to be higher at this monitoring site and that the exceptional event exceedances at the San Andreas monitoring station are not clearly distinguishable from non-event exceedances as defined by guidance, disqualifying the exceptional events from a Tier 1 analysis.[19]

Tier 1: Key Factor

To meet the key factor for a Tier 1 analysis, exceedances should be clearly higher than other non-event related exceedances or occur during a time of year that typically experiences no exceedances. The exceedances identified in this demonstration occurred within the O_3 season and were measured when exceedances have historically been observed at the San Andreas monitoring site. The O_3 concentrations on event days identified in this demonstration do not exceed non-event exceedance concentrations by at least five ppb.[20] Therefore, the exceedances do not meet the Tier 1 Key Factor, and additional evidence beyond a Tier 1 analysis is needed to support the clear causal relationship.

[18] See demonstration, pp. 80-82; Appendix II-A, pp. 168-172.
[19] See demonstration, pp. 83-85.
[20] See demonstration, pp. 83-85.

Tier 2: Key Factors

The demonstration included an evaluation of the Tier 2 Key Factors. For Tier 2 Key Factor 1, the demonstration provided an analysis of fire emissions (Q) and distance (D) of the wildfires to the monitoring site locations. The Q/D value is generally calculated by dividing wildfire emissions (in tons per day) by the distance between the wildfire and the monitoring site (in kilometers [km]). Daily Q/D values were calculated by the EPA using Community Multiscale Air Quality (CMAQ) modeling system daily wildland fire emissions input files. The resulting calculations were shared with CARB to assist in demonstration development. CMAQ input files included daily total emissions of nitrogen oxide, nitrogen dioxide, and reactive organic gases at release points corresponding to wildfire locations. Q/D was calculated for each CMAQ input release point by calculating the distance between release point locations and gridded receptor locations and dividing the associated fire's daily emissions by this distance. An aggregated daily Q/D was then calculated by summing the individual Q/D values for each release point. An "effective Q/D" value was then calculated at monitoring site receptor locations by accounting for periods where multiple days of wildfire smoke buildup impacted the monitoring site for up to three total days; the dates to include in each daily "effective Q/D" were based on meteorology and transport analyses, with the rationale further outlined in the demonstration.[21] The distance-weighted sums for all dates requested as exceptional events at the San Andreas monitoring site except for August 10, 2018, are greater than 100 tons per day of NO_X and VOC per km.[22] Therefore, the event exceedances for all dates except for August 10, 2018, meet Tier 2 Key Factor 1. The demonstration noted that enhanced wildfire impacts for August 10, 2018 are also considered qualifying because they occurred at the end of a prolonged event; wildfire emissions were decreasing but remained elevated, and residual local effects continued to impact O_3 concentrations at the monitoring site.[23] Since all of the dates but one meet Tier 2 Key Factor 1, and the date that does not follows several days of requested exclusions that do meet the Key Factor, it is appropriate to consider all days included in the demonstration as meeting Tier 2 Key Factor 1 for the purposes of determining the appropriate tier for this demonstration.

For Tier 2 Key Factor 2, the demonstration included evidence that the exceedances, including August 10, 2018, are at or above the 99th percentile from the past five years of O_3 season data (2013-2017) or among the four highest concentrations measured at the site in 2018. In the demonstration, CARB determined an "adjusted 4th high" corresponding to the 4th highest non-event exceedance monitored in 2018, excluding the exceedances included in the demonstration.[24] CARB noted that dates impacted by exceptional events should not count against the tally of the four highest O_3 concentrations measured in 2018 because these exceedances were caused by contributions from wildfire emissions.[25] This rationale is supported given that the purpose of the test is to show that the exceedances are high compared to non-event data. Since the excluded dates are all included in the demonstration being evaluated in this TSD, each individual date would not count towards the four highest concentrations if concurred on by the EPA. As demonstrated in Table 4-6 of the demonstration, the monitored O_3 concentration on all dates, including August 10, 2018, requested as exceptional events exceed the adjusted 4th high O_3

[21] See demonstration, pp. 92-94.
[22] See demonstration, pp. 93-94.
[23] See demonstration, pp. 94.
[24] See demonstration, p. 99.
[25] See demonstration, pp. 98-99.

concentration at the San Andreas monitoring site in 2018.[26] Therefore, the event exceedances meet Tier 2 Key Factor 2.

Based on the analysis of the Key Factors for Tier 2, the EPA's wildfire O_3 guidance document indicates that a Tier 2 analysis is appropriate for this event. As described below, the demonstration included the required elements for a Tier 2 clear causal relationship analysis based on the EPA's wildfire O_3 guidance document. This includes evidence to support that (1) wildfire emissions were transported from the wildfire to the monitor; and (2) wildfire emissions affected the monitor.

Evidence of transport of wildfire emissions from the wildfire to the monitor

The demonstration presented analyses in the Narrative Conceptual Model and Appendix IV using backward trajectory and forward trajectory modeling.[27] HYSPLIT modeling was used to determine back trajectories and forward trajectories that estimate the movement of air parcels and smoke during the event time period.[28] HYSPLIT back trajectories initiated from the monitor location showing the likely path of air parcels for 36 hours prior to the time of peak concentrations on July 30 and August 10, 2018, at three elevations (100 meters (m), 500 m, and 1,000 m) were overlaid on National Oceanic and Atmospheric Administration (NOAA) HMS Fire and Smoke Product imagery. HYSPLIT forward trajectories showing the most likely center path of air parcels for 36 hours beginning at the wildfire location for July 30 and August 10, 2018 were overlaid on satellite imagery to provide a visual analysis of whether smoke emitted from the fires may have impacted ambient O_3 concentrations at the San Andreas monitoring site. The back trajectories from the San Andreas monitoring site on July 28, 2018, pass over the area of the River (Mendocino Complex) fire at 500 m and over the area of the Butte fire at 1,000 m; the back trajectories from the San Andreas monitor on August 2 and August 10, 2018, also pass near the area of the River fire at 500 m and 1,000 m.[29] Additionally, forward trajectories from the River fire on July 27, 2018, and the Donnell fire on August 8, 2018, pass over the location of the San Andreas monitor.[30] The back trajectory analyses from the monitor and forward trajectory analyses from the fire locations support that wildfire emissions may have been transported to the San Andreas monitoring site on the days requested for exclusion as exceptional events.

Evidence that the wildfire emissions affected the monitor

The demonstration provided analyses in Sections II and III of the Narrative Conceptual Model chapter of the demonstration, as well as Section III of the Clear Causal Relationship chapter of the demonstration, as evidence that wildfire emissions affected the San Andreas monitoring site on the exceptional event dates requested for exclusion. In particular, the demonstration included evidence of a correlation between O_3 and $PM_{2.5}$ concentrations in Figure 3-27.[31] This correlation provides strong evidence that the increase in O_3 resulted from the impact of wildfire emissions in the nonattainment area, as shown by the simultaneous, large increases in $PM_{2.5}$ concentrations evident between July 29 and August 10, 2018. The demonstration also included figures comparing the daily diurnal pattern of 1-hour O_3 concentrations on each exceptional event day to

[26] See demonstration, p. 99.
[27] See demonstration, p. 105.
[28] See demonstration, pp. 41-61.
[29] See demonstration, Appendix IV, pp. 307-309.
[30] See demonstration, Appendix IV, pp. 291, 305.
[31] See demonstration, p. 62.

hourly diurnal O_3 percentiles from 2013 to 2017.[32] Overall, these figures show that O_3 peak concentrations, typically between the 13th and 18th hour, were above the 95th percentile of O_3 concentrations between 2013 and 2017 and substantially deviated from the normal diurnal patterns on July 30, July 31, August 2, and August 5, 2018.

The demonstration included charts of daily $PM_{2.5}$ concentrations at the San Andreas monitoring site as well as charts showing concentrations of biomass burning indicators at nearby monitoring sites. Figure 4-67 of the demonstration showed elevated $PM_{2.5}$ concentrations on the exceptional event days, consistent with wildfire smoke and emissions directly impacting the monitoring site at ground level on the exceptional event days.[33] The demonstration also included black carbon and biomass burning indicator analyses. Figure 4-70 of the demonstration showed the concentrations of three biomass burning indicators (levoglucosan, mannosan, and galactosan) measured at Portola, Chico, and Sacramento between July 1 and August 31, 2018. Although these sites do not consistently monitor during the summer months, they were active during the summer of 2018.[34] The two samples collected during the time addressed in this demonstration, on July 31 and August 6, 2018, show concentrations across all three sites that are among the highest concentrations measured during the period in the figures. Elevated concentrations of these biomass burning indicators during the time of the requested exceptional event support the presence of wildfire smoke in the area. The demonstration also included a map of black carbon smoke plumes associated with the Carr, Mendocino Complex (i.e., Ranch and River), and Ferguson fires, and noted that wildfires are a major source of black carbon emissions in California.[35] The map indicates higher concentrations of atmospheric black carbon over Calaveras County, between the Ferguson and Mendocino Complex fires, supporting evidence of wildfire smoke reaching the San Andreas monitoring site during the time of the exceedances.

As additional evidence to support that wildfire emissions affected the San Andreas monitoring site, the demonstration included language from the NOAA Smoke Text Product on July 26, 2018, describing smoke plume coverage in the Western United States (Figure 4-74).[36] The language in Figure 4-74 describes that thick smoke was located close to active fires and that moderately dense smoke covered a wide area of land including parts of Southwestern Oregon, California, and Northwestern Nevada. This language generally suggests that smoke from numerous wildfires (such as the Ferguson and Carr fires in California) may have reached the ground and impacted the San Andreas monitoring station during the time of the exceedances.

Conclusion

The analyses included in the demonstration, specifically comparison to historical concentrations, Tier 2 Key Factors, Q/D analyses, HYSPLIT modeling and satellite observations of smoke, correlation between $PM_{2.5}$ and O_3 during the event dates, evidence of impacts to hourly O_3 data, presence of biomass burning tracers, and related NOAA statements on smoke, sufficiently demonstrate a clear causal relationship between the emissions generated by the numerous

[32] See demonstration, pp. 105-109.
[33] See demonstration, pp. 136-137.
[34] See demonstration, pp. 138-139.
[35] See demonstration, pp. 140-141.
[36] See demonstration, pp. 142-143.

wildfires in Northern and Central California and Southern Oregon and the exceedances measured at the San Andreas monitoring site.

Table 3: Documentation of the Clear Causal Relationship criterion

Exceedance Dates	Demonstration Citation	Quality of Evidence	Criterion Met?
July 28, July 30-31, August 2, August 5, August 8-10, 2018	"Narrative Conceptual Model – July 26-August 10, 2018": pp. 27-82 "Clear Causal Relationship": pp. 83-144	Sufficient	Yes

Not Reasonably Controllable or Preventable

The Exceptional Events Rule presumes that wildfire events on wildland are not reasonably controllable or preventable [40 CFR §50.14(b)(4)]. The demonstration provided evidence that the wildfire event meets definition of wildfire [40 CFR §50.1(n)]. Specifically, the demonstration included maps and descriptions of the wildfires discussed in this demonstration, along with figures showing wildfire boundaries overlaid upon land ownership and wildland-urban interface layers to demonstrate that the fires occurred on wildland or in the urban/wildland interface.[37] The demonstration described that CARB is not aware of any evidence clearly demonstrating that prevention or control efforts beyond those actually made would have been reasonable.[38] Therefore, the documentation provided sufficiently demonstrates that the event was not reasonably controllable and not reasonably preventable.

Table 4: Documentation of the Not Reasonably Controllable or Preventable criterion

Exceedance Dates	Demonstration Citation	Quality of Evidence	Criterion Met?
July 28, July 30-31, August 2, August 5, August 8-10, 2018	"Narrative Conceptual Model – July 26-August 10, 2018": pp. 27-40 "Not Reasonably Controllable and/or Not Reasonably Preventable": p. 145	Sufficient	Yes

Natural Event

The definition of "wildfire" at 40 CFR §50.1(n) states, "A wildfire that predominantly occurs on wildland is a natural event." As previously described, the demonstration included documentation that the event meets the definition of a wildfire and occurred predominantly on wildland and has therefore shown that the event was a natural event.

Table 5: Documentation of the Natural Event criterion

Exceedance Dates	Demonstration Citation	Quality of Evidence	Criterion Met?
July 28, July 30-31, August 2, August 5, August 8-10, 2018	"Narrative Conceptual Model – July 26-August 10, 2018": pp. 27-40 "Natural Event/Human Activity Unlikely to Recur": p. 145	Sufficient	Yes

[37] See demonstration, pp. 27-40.
[38] See demonstration, p. 145.

Schedule and Procedural Requirements

In addition to technical demonstration requirements, 40 CFR §50.14(c) and 40 CFR §51.930 specify schedule and procedural requirements an air agency must follow to request data exclusion. Table 6 outlines the EPA's evaluation of these requirements.

Table 6: Schedules and Procedural Criteria

	Reference	Demonstration Citation	Criterion Met?
Did the agency provide prompt public notification of the event?	40 CFR §50.14 (c)(1)(i)	"Narrative Conceptual Model – July 26-August 10, 2018": p. 79; Appendix II-A: pp. 168-172	Yes
Did the agency submit an Initial Notification of Potential Exceptional Event and flag the affected data in the EPA's Air Quality System (AQS)?	40 CFR §50.14 (c)(2)(i)	Appendix I-A: pp. 150-151.	Yes
Did the initial notification and demonstration submittals meet the deadlines for data influenced by exceptional events for use in initial area designations, if applicable? Or the deadlines established by the EPA during the Initial Notification of Potential Exceptional Events process, if applicable?	40 CFR §50.14 Table 2 40 CFR §50.14 (c)(2)(i)(B)	Letter from Gwen Yoshimura, EPA R9, to Sylvia Vanderspek, CARB, dated April 21, 2021.	Yes
Was the public comment process followed and documented? • Did the agency document that the comment period was open for a minimum of 30 days? • Did the agency submit to the EPA any public comments received? • Did the state address comments disputing or contradicting factual evidence provided in the demonstration?	40 CFR §50.14 (c)(3)(v)	Letter from Michael Benjamin, CARB, to Elizabeth Adams, EPA R9, dated October 28, 2021.	Yes
Has the agency met requirements regarding submission of a mitigation plan, if applicable?	40 CFR §51.930 (b)	N/A	N/A

Conclusion

The EPA has reviewed the documentation provided by CARB to support claims that smoke from wildfires in Northern and Central California and Southern Oregon, namely the Ranch, River, Carr, Donnell, and Ferguson fires, caused exceedances of the 2015 8-hour O_3 NAAQS at the San Andreas monitoring site on July 28, July 30-31, August 2, August 5, and August 8-10, 2018. The EPA has determined that the flagged exceedances at this monitoring site on these days satisfies the exceptional event criteria: the event was a natural event, which affected air quality in such a way that there exists a clear causal relationship between the event and the monitored

exceedances and was not reasonably controllable or preventable. The EPA has also determined that CARB has satisfied the schedule and procedural requirements for data exclusion.

ENCLOSURE: TECHNICAL SUPPORT DOCUMENT FOR EPA CONCURRENCE ON O_3 EXCEEDANCES MEASURED IN BUTTE COUNTY (PARADISE), CALIFORNIA ON JULY 26-28, JULY 30-AUGUST 2, AND AUGUST 7-10, 2018 AS AN EXCEPTIONAL EVENT

On September 17, 2021, California Air Resources Board (CARB) submitted an exceptional event demonstration for exceedances of the 2015 8-hour ozone (O_3) National Ambient Air Quality Standards (NAAQS) of 0.070 parts per million (ppm) that occurred at the Paradise-4405 Airport Road monitoring site on July 26-28, July 30-August 2, and August 7-10, 2018.[1] The demonstration submitted by CARB stated that the exceedances measured between July 26 and August 10, 2018 were caused by multiple wildfires burning in Northern California, namely the Ranch, River, Carr, Donnell, Ferguson, and Natchez fires, and the Taylor Creek and Klondike fires in Southern Oregon.[2] Under the Exceptional Events Rule, air agencies can request the exclusion of event-influenced data, and the EPA can agree to exclude these data, from the data set used for certain regulatory decisions. The remainder of this document summarizes the Exceptional Events Rule requirements, the event and the EPA's review process.

EXCEPTIONAL EVENTS RULE REQUIREMENTS

The EPA promulgated the Exceptional Events Rule in 2007, pursuant to the 2005 amendment of Clean Air Act (CAA) Section 319. In 2016, the EPA finalized revisions to the Exceptional Events Rule. The 2007 Exceptional Events Rule and 2016 Exceptional Events Rule revisions added sections 40 CFR §50.1(j)-(r); §50.14; and §51.930 to title 40 of the Code of Federal Regulations (CFR). These sections contain definitions, criteria for EPA approval, procedural requirements, and requirements for air agency demonstrations. The EPA reviews the information and analyses in the air agency's demonstration package using a weight of evidence approach and decides to concur or not concur. The demonstration must satisfy all of the Exceptional Events Rule criteria for the EPA to concur with excluding the air quality data from regulatory decisions.

Under 40 CFR §50.14(c)(3)(iv), the air agency demonstration to justify exclusion of data must include:

A. "A narrative conceptual model that describes the event(s) causing the exceedance or violation and a discussion of how emissions from the event(s) led to the exceedance or violation at the affected monitor(s);"

B. "A demonstration that the event affected air quality in such a way that there exists a clear causal relationship between the specific event and the monitored exceedance or violation;"

C. "Analyses comparing the claimed event-influenced concentration(s) to concentrations at the same monitoring site at other times" to support requirement (B) above;

[1] "Exceptional Events Demonstration for Ozone Exceedances; Northern California; July-August 2018 Wildfire Events" (September 17, 2021) ("demonstration"). The demonstration addresses multiple events and exceedances measured in Northern California in July – August 2018. The EPA's evaluation of the information presented in the demonstration is reflected in eight separate TSDs, grouped by nonattainment area affected.
[2] See demonstration, pp. 63-64.

D. "A demonstration that the event was both not reasonably controllable and not reasonably preventable;" and

E. "A demonstration that the event was a human activity that is unlikely to recur at a particular location or was a natural event."[3]

In addition, the air agency must meet several procedural requirements, including:

1. submission of an Initial Notification of Potential Exceptional Event and flagging of the affected data in the EPA's Air Quality System (AQS) as described in 40 CFR §50.14(c)(2)(i),

2. completion and documentation of the public comment process described in 40 CFR §50.14(c)(3)(v), and

3. implementation of any relevant mitigation requirements as described in 40 CFR §51.930.

For data influenced by exceptional events to be excluded from use in initial area designations, air agencies must also meet the initial notification and demonstration submission deadlines specified in Table 2 to 40 CFR §50.14. We include below a summary of the Exceptional Events Rule criteria, including those identified in 40 CFR §50.14(c)(3)(iv).

Regulatory Significance

The 2016 Exceptional Events Rule includes regulatory language that applies the provisions of CAA section 319 to a specific set of regulatory actions. As identified in 40 CFR §50.14(a)(1)(i), these regulatory actions include initial area designations and redesignations; area classifications; attainment determinations (including clean data determinations); attainment date extensions; findings of State Implementation Plan (SIP) inadequacy leading to a SIP call; and other actions on a case-by-case basis as determined by the Administrator. Air agencies and the EPA should discuss the regulatory significance of an exceptional events demonstration during the Initial Notification of Potential Exceptional Event prior to the air agency submitting a demonstration for the EPA's review.

Narrative Conceptual Model

The 2016 Exceptional Events Rule directs air agencies to submit, as part of the demonstration, a narrative conceptual model of the event that describes and summarizes the event in question and provides context for analyzing the required statutory and regulatory technical criteria. Air agencies may support the narrative conceptual model with summary tables or maps. For wildfire O_3 events, the EPA recommends that the narrative conceptual model also discuss the interaction of emissions, meteorology, and chemistry of event and non-event O_3 formation in the area, and,

[3] A natural event is further described in 40 CFR 50.1(k) as "an event and its resulting emissions, which may recur at the same location, in which human activity plays little or no direct causal role. For purposes of the definition of a natural event, anthropogenic sources that are reasonably controlled shall be considered to not play a direct role in causing emissions."

under 40 CFR §50.14(a)(1)(i), must describe the regulatory significance of the proposed data exclusion.

Clear Causal Relationship and Supporting Analyses

The EPA considers a variety of evidence when evaluating whether there is a clear causal relationship between a specific event and the monitored exceedance or violation. For wildfire O_3 events, air agencies should compare the O_3 data requested for exclusion with seasonal and annual historical concentrations at the air quality monitor to establish a clear causal relationship between the event and monitored data. In addition to providing this information on the historical context for the event-influenced data, air agencies should further support the clear causal relationship criterion by demonstrating that the wildfire's emissions were transported to the monitor, that the emissions from the wildfire influenced the monitored concentrations, and, in some cases, air agencies may need to provide evidence of the contribution of the wildfire's emissions to the monitored O_3 exceedance or violation.

For wildfire O_3 events, the EPA has published a guidance document that provides three different tiers of analyses that apply to the "clear causal relationship" criterion within an air agency's exceptional events demonstration.[4] This tiered approach recognizes that some wildfire events may be more clear and/or extreme and, therefore, require relatively less evidence to satisfy the rule requirements. If a wildfire/O_3 event satisfies the key factors for either Tier 1 or Tier 2 clear causal analyses, then those analyses are the only analyses required to support the clear causal relationship criterion within an air agency's demonstration for that particular event. Other wildfire/O_3 events will be considered based on Tier 3 analyses.

- Tier 1: Wildfires that clearly influence monitored O_3 exceedances or violations when they occur in an area that typically experiences lower O_3 concentrations.
    - *Key Factor*: seasonality and/or distinctive level of the monitored O_3 concentration. The event-related exceedance occurs during a time of year that typically has no exceedances, or is clearly distinguishable (*e.g.*, 5-10 parts per billion (ppb) higher) from non-event exceedances.
    - In these situations, O_3 impacts should be accompanied by clear evidence that the wildfire's emissions were transported to the location of the monitor.

- Tier 2: The wildfire event's O_3 influences are higher than non-event related concentrations, and fire emissions compared to the fire's distance from the affected monitor indicate a clear causal relationship.
    - *Key Factor 1*: fire emissions and distance of fire(s) to affected monitoring site location(s). Calculated fire emissions of nitrogen oxides (NO_x) and reactive-volatile organic compounds (VOC) in tons per day (Q) divided by the distance from the fire to the monitoring site (D) should be equal to or greater than 100 tons per day/kilometers ($Q/D \geq 100$ tpd/km). The guidance document provides additional information on the calculation of Q/D.

[4] "Guidance on the Preparation of Exceptional Events Demonstrations for Wildfire Events that May Influence Ozone Concentrations" (September 2016) ("wildfire O_3 guidance document").

- *Key Factor 2*: comparison of the event-related O_3 concentration with non-event related high O_3 concentrations. The exceedance due to the exceptional event:
  - is in the 99th or higher percentile of the 5-year distribution of O_3 monitoring data, OR
  - is one of the four highest O_3 concentrations within 1 year (among those concentrations that have not already been excluded under the Exceptional Events Rule, if any).
- In addition to the analysis required for Tier 1, the air agency should supply additional evidence to support the weight of evidence that emissions from the wildfire affected the monitored O_3 concentration.

- Tier 3: The wildfire does not fall into the specific scenarios (i.e., does not meet the key factors) that qualify for Tier 1 or Tier 2, but the clear causal relationship criterion can still be satisfied by a weight of evidence showing.
  - In addition to the analyses required for Tier 1 and Tier 2, an air agency may further support the clear causal relationship with additional evidence that the fire emissions caused the O_3 exceedance.

Not Reasonably Controllable or Preventable

The Exceptional Events Rule requires that air agencies establish that the event be both not reasonably controllable and not reasonably preventable at the time the event occurred. This requirement applies to both natural events and events caused by human activities; however, it is presumed that wildfires on wildland will satisfy both factors of the "not reasonably controllable or preventable" element unless evidence in the record clearly demonstrates otherwise.[5]

Natural Event

According to the CAA and the Exceptional Events Rule, an exceptional event must be "an event caused by human activity that is unlikely to recur at a particular location *or* a natural event" (emphasis added). The 2016 Exceptional Events Rule includes in the definition of wildfire that "[a] wildfire that predominantly occurs on wildland is a natural event." Once an agency provides evidence that a wildfire on wildland occurred and demonstrates that there is a clear causal relationship between the measurement under consideration and the event, the EPA expects minimal documentation to satisfy the "human activity that is unlikely to recur at a particular location or a natural event" element. The EPA will address wildfires on other lands on a case-by-case basis.

EPA REVIEW OF EXCEPTIONAL EVENTS DEMONSTRATION

On March 15, 2021, CARB submitted an Initial Notification of a potential Exceptional Event for 16 exceedances of the 2015 8-hour O_3 NAAQS that occurred in 2018 at the Paradise-4405

[5] A wildfire is defined in 40 CFR 50.1(n) as "any fire started by an unplanned ignition caused by lightning; volcanoes; other acts of nature; unauthorized activity; or accidental, human-caused actions, or a prescribed fire that has developed into a wildfire. A wildfire that predominantly occurs on wildland is a natural event." Wildland is defined in 40 CFR 50.1(o) as "an area in which human activity and development are essentially non-existent, except for roads, railroads, power lines, and similar transportation facilities. Structures, if any, are widely scattered."

Airport Road monitoring site within the Chico Metropolitan Statistical Area (MSA) in Butte County, California between July 26 and August 25, 2018.[6] On September 17, 2021, CARB submitted an exceptional event demonstration for 11 exceedances of the 2015 8-hour O_3 NAAQS that occurred at the Paradise-4405 Airport Road monitoring site within the Chico MSA in Butte County, California on July 26-28, July 30-August 2, and August 7-10, 2018.[7]

Regulatory Significance

The EPA determined that data exclusion of certain exceedances referenced in the Initial Notification may have a regulatory significance for the determination of attainment by the attainment date for the Butte County, CA Marginal nonattainment area for the 2015 8-hour O_3 NAAQS, and worked with CARB to identify the relevant exceedances and monitoring site affected.[8] Table 1 summarizes the exceedances measured at the Paradise-4405 Airport Road monitoring site that CARB included in the demonstration.[9]

Table 1: 2015 8-hour O_3 NAAQS Exceedance Summary

Exceedance Date	Monitoring Site Name	AQS ID	2015 8-hour Avg. (ppm)
July 26, 2018	Paradise-4405 Airport Road	06-007-0007	0.075
July 27, 2018	Paradise-4405 Airport Road	06-007-0007	0.080
July 28, 2018	Paradise-4405 Airport Road	06-007-0007	0.079
July 30, 2018	Paradise-4405 Airport Road	06-007-0007	0.074
July 31, 2018	Paradise-4405 Airport Road	06-007-0007	0.086
August 1, 2018	Paradise-4405 Airport Road	06-007-0007	0.098
August 2, 2018	Paradise-4405 Airport Road	06-007-0007	0.081
August 7, 2018	Paradise-4405 Airport Road	06-007-0007	0.078
August 8, 2018	Paradise-4405 Airport Road	06-007-0007	0.076
August 9, 2018	Paradise-4405 Airport Road	06-007-0007	0.088
August 10, 2018	Paradise-4405 Airport Road	06-007-0007	0.084

Narrative Conceptual Model

The demonstration submitted by CARB provided a narrative conceptual model in the "Overview/Introduction," "Background," and "Narrative Conceptual Model – July 26-August 10, 2018" chapters of the demonstration to describe how emissions from multiple wildfires burning in the Northern California, namely the Ranch, River, Carr, Donnell, Ferguson, and Natchez fires, and the Taylor Creek and Klondike fires in Southern Oregon caused the O_3 exceedances at the Paradise-4405 Airport Road monitoring site. The narrative conceptual model addressed the regulatory significance of the exceptional event by stating that the exclusion of wildfire events in 2018 and 2020 would affect determination of attainment for the Butte County, CA Marginal nonattainment area for the 2015 NAAQS.[10]

[6] See email from Sylvia Vanderspek, CARB, to Gwen Yoshimura, EPA Region 9, dated March 15, 2021.
[7] See letter from Michael Benjamin, CARB, to Elizabeth Adams, EPA Region 9, dated September 17, 2021.
[8] See letter from Elizabeth Adams, EPA Region 9, to Sylvia Vanderspek, CARB, dated August 27, 2021.
[9] See demonstration, p. 8.
[10] See demonstration pp. 2-8.

The "Overview/Introduction" and "Background" sections of the demonstration provided information supporting the narrative conceptual model including characteristics of the nonattainment area and surrounding areas, such as geography, topography, meteorology, the ambient O_3 monitoring network, descriptions of typical O_3 formation emissions, and seasonal O_3 variations.[11]

The narrative conceptual model described event-related characteristics and indicated that the observed exceedances were caused by emissions from multiple fires burning in Northern California and Southern Oregon and that these exceedances qualify as an exceptional event. The demonstration noted that there were multiple major fires actively burning simultaneously, making identifying the impacts of just one particular wildfire difficult, as all the fires contributed to the accumulation of smoke layers over California.[12] The demonstration specifically identified nine fires that produced the most emissions, and provided a list of the actively burning wildfires in Northern California and Southern Oregon from July 13 through August 2018 with information such as the start/end date, total acres burned and the fire perimeter in acres, along with a map of their locations.[13]

The narrative conceptual model included descriptions of the general meteorological conditions that led to transport of wildfire emissions from the fires in Northern California and Southern Oregon to the nonattainment area.[14] The demonstration provided daily surface weather, temperature, and pressure maps from the National Weather Service (NWS) for July 26 to August 10, 2018 in Appendix III.[15] The demonstration also provided Hazard and Mapping System (HMS) smoke maps along with Hybrid Single Particle Lagrangian Integrated Trajectory (HYSPLIT) trajectories from the Paradise-4405 Airport Road monitoring site and wildfire locations to support that wildfire emissions were transported to the Paradise-4405 Airport Road monitoring site on the exceptional event dates requested for exclusion.[16]

The narrative conceptual model presented a graph of the 1-hour O_3 concentrations measured at the Paradise-4405 Airport Road monitoring site and 1-hour particulate matter less than or equal to 2.5 microns in aerodynamic diameter ($PM_{2.5}$) concentrations measured at the nearby Paradise-Theater site from July 15 to August 15, 2018. The demonstration stated that "the timing of relative $PM_{2.5}$ elevated concentrations show strong connection with ozone increases and prolonged elevated concentrations," supporting the presence of wildfire smoke.[17] Graphs of 8-hour yearly design values, and annual 4th high 8-hour average O_3 values from 2009-2020 were presented with the level of NAAQS, trend line, and 2018, 2019, and 2020 values with and without the exceptional event dates included.[18] The narrative conceptual model also presented tables with the daily 1-hour and 8-hour maximum O_3 values, temperature, and wind speed for

[11] See demonstration, pp. 12-13, 17-19, 21, 26, 63-65.
[12] See demonstration, p. 27.
[13] See demonstration, pp. 29-40.
[14] See demonstration, pp. 40-61.
[15] See demonstration, Appendix III-A, pp. 215-223. pp. 29-40.
[15] See demonstration, pp. 40-61.
[15] See demonstration, Appendix III-A, pp. 215-223.
[16] See demonstration, pp. 44-61, Appendix IV, pp. 241-307, 310-313.
[17] See demonstration, p. 64.
[18] See demonstration, p. 65.

July 26 through August 10, 2018 and concluded that unusual weather, other than transport of O_3 and related wildfire smoke, was not a contributing factor to the exceptional event.[19]

The demonstration also included National Weather Area Forecast notices and National Oceanic and Atmospheric Administration (NOAA) Smoke Text Alerts that cited wildfire and smoke were impacting air quality over large areas of Northern California and the Central Valley, as well as extensive media and social media coverage.[20]

Based on the information described above, the demonstration submitted by CARB meets the narrative conceptual model criterion of the Exceptional Events Rule (EER).

Table 2: Documentation of the Narrative Conceptual Model

Exceedance Date	**Demonstration Citation**	**Quality of Evidence**	**Criterion Met?**
July 26-28, 2018 July 30-August 2, 2018 August 7-10, 2018	"Overview/Introduction": pp. 1-9 "Background": pp. 10-13, 17-19, 21, 26 "Narrative Conceptual Model": pp. 27, 29-61, 64-65, 75 Appendix III-A: pp. 215-223 Appendix III-B: pp. 223-238 Appendix V: pp. 327-338 Appendix VI: pp. 339-364	Sufficient	Yes

Clear Causal Relationship

The demonstration included several analyses to support a clear causal relationship between the wildfire event and the monitored exceedances. These analyses are presented in Narrative Conceptual Model's Section II "Summary of Event" and Section III "Event Related Concentrations and Long-Term Trends" Part B, and "Clear Causal Relationship."

Comparison with historical concentrations

The demonstration included a comparison with historical concentrations, as required by 40 CFR §50.14(c)(3)(iv)(C). The demonstration compared O_3 concentrations at Paradise-4405 Airport Road monitoring site on the 2018 wildfire exceptional event days to historical non-event O_3 concentrations from 2013-2018. This includes the trends in 8-hour O_3 design values and the annual 4th highest maximum 8-hour averages over the six-year period by day of year, along with the level of the NAAQS and the 99th percentile value at the site.[21] The historical concentration plots provided show that 9 of the demonstration days are above the 99th percentile of 0.075 ppm, and that other exceedances have been observed throughout the summer months.

[19] See demonstration, pp. 74-76.
[20] See demonstration, Appendix III-B, pp. 223-238, Appendix V, pp. 327-338, Appendix VI, 339-364.
[21] See demonstration, pp. 63-65, 86.

Tier 1: Key Factor

To meet the key factor for a Tier 1 analysis, exceedances should be clearly higher than other non-event related exceedances or occur during a time of year that typically experiences no exceedances. The exceedances identified in this demonstration occurred during the time of year where O_3 concentrations tend to be higher at this monitoring site, and that these exceedances are not clearly distinguishable from non-event exceedances as defined by guidance.[22]

The demonstration notes that the Paradise (Butte County) exceedance on August 1, 2018, of 0.098 ppm was the greatest concentration during the 2013-2018 time period and was 5 ppb higher than the second greatest concentration on July 2, 2013 of 0.093 ppm, qualifying for Tier 1 analysis. The exceedance is discussed and included as part of the Tier 2 analysis necessary for the other exceptional event dates at Paradise.[23] As stated above, the remainder of the exceedances at Paradise do not meet the Tier 1 Key Factor and additional evidence beyond a Tier 1 analysis is needed to support the clear causal relationship.

Tier 2: Key Factors

The demonstration included an evaluation of the Tier 2 Key Factors. For Tier 2 Key Factor 1, the demonstration provided an analysis of fire emissions (Q) and distance (D) of the wildfires to the monitoring site locations. The Q/D value is generally calculated by dividing wildfire emissions (in tons per day) by the distance between the wildfire and the monitoring site (in kilometers [km]). Daily Q/D values were calculated by the EPA using daily wildland fire emissions input files originally created for the Community Multiscale Air Quality (CMAQ) modeling system. The resulting calculations were shared with CARB to assist in demonstration development. CMAQ input files included daily total emissions of nitrogen oxide (NO), nitrogen dioxide (NO_2), and reactive organic gases (ROG) at release points corresponding to wildfire locations. Q/D was calculated for each CMAQ input release point by calculating the distance between release point locations and gridded receptor locations and dividing the associated fire's daily total emissions by this distance. An aggregated daily Q/D was then calculated by summing the individual Q/D values for each release point. An "effective Q/D" value was then calculated at monitoring site receptor locations by accounting for periods where multiple days of wildfire smoke buildup impacted the monitoring site for up to three total days; the dates to include in each daily "effective Q/D" was based on meteorology and transport analyses, with the rationale further outlined in the demonstration.[24] The distance-weighted sum for all dates requested as exceptional events, except August 10, 2018, at the Paradise-4405 Airport Road monitoring site are greater than the Tier 2 Key Factor 1 screening value of 100 tons per day of NO_X and VOC per km.[25] Therefore, the event exceedances meet Tier 2 Key Factor 1. The demonstration noted that enhanced wildfire impacts for August 10, 2018, are also considered qualifying due to occurring at the end of a prolonged event; wildfire emissions were decreasing but remained elevated, and residual local effects continued to impact O_3 concentrations at the monitoring site.[26] Since all of the dates but one meet Tier 2 Key Factor 1, and the date that does not follows several days of requested exclusions that do meet the Key Factor, it is appropriate to consider all days included

[22] See demonstration, pp. 83-84.
[23] See demonstration, p.84.
[24] See demonstration, pp. 92-93.
[25] See demonstration pp. 94-95.
[26] See demonstration, p. 94.

in the demonstration as meeting Tier 2 Key Factor 1 for the purposes of determining the appropriate tier for this demonstration.

For Tier 2 Key Factor 2, the demonstration included evidence that the exceedances, including August 10, 2018, are at or above the 99th percentile from the past five years of O_3 season data (January-December 2013-2017) or are among the adjusted four highest concentrations measured at the site in 2018.[27] In the demonstration, CARB determined an "adjusted 4th high" corresponding to the 4th highest non-event exceedance monitored in 2018, excluding the exceedances included in the demonstration.[28] CARB stated that dates impacted by exceptional events should not count against the tally of the four highest O_3 concentrations measured in 2018 because these exceedances were caused by contributions from wildfire emissions.[29] This rationale is supported given that the purpose of this test is to show that the exceedances are high compared to non-event data. Since the excluded dates are all included in the demonstration being evaluated in this technical support document, each individual date would not count towards the four highest concentrations if concurred on by the EPA. As shown in Table 4-7 of the demonstration, the max daily 8-hour O_3 concentration for all of the days requested as exceptional events met or exceeded the adjusted 4th high O_3 concentration measured at the Paradise-4405 Airport Road monitoring site in 2018. Therefore, the event exceedances meet Tier 2 Key Factor 2.

Based on the analysis of the Key Factors for Tier 2, the EPA's wildfire O_3 guidance document indicates that a Tier 2 analysis is appropriate for most days of this event (as described above, one day qualifies for a Tier 1 analysis). As described below, the demonstration included the required elements for a Tier 2 clear causal relationship analysis based on the EPA's wildfire O_3 guidance document. This includes evidence to support that (1) wildfire emissions were transported from the wildfire to the monitor; and (2) wildfire emissions affected the monitor.

Evidence of transport of wildfire emissions from the wildfire to the monitor

The demonstration presented a trajectory analysis in the Narrative Conceptual Model chapter and Appendix IV using HYSPLIT modeling to determine back trajectories and forward trajectories that estimate the movement of air parcels and smoke during the event time period.[30] HYSPLIT back trajectories initiated from the monitor location showing the likely path of air parcels for 36 hours prior to the time of peak concentrations on July 27, July, 30, August 1, August 7, and August 10, 2018, at three elevations (100 meters (m), 500 m, and 1,000 m) were overlaid on NOAA HMS Fire and Smoke Product imagery.[31] The demonstration's Appendix IV continues with an analysis of back trajectories tracing the path emissions took from the Paradise monitoring site on each exceedance day (not overlaid on a smoke map). The demonstration listed each exceedance date and identified the first hour of the exceeding 8-hour time period and the maximum hour within that 8-hour time period.[32]

[27] See demonstration, p. 100.
[28] See demonstration, pp. 98-100.
[29] See demonstration, pp. 98-99.
[30] See demonstration, pp. 46-61, Appendix IV, pp. 241-307, 310-313.
[31] See demonstration, pp. 45, 47, 51, 58, 61.
[32] See demonstration, Appendix IV, pp. 310-313.

HYSPLIT forward trajectories showing the most likely center path of air parcels for 36 hours beginning at the wildfire location on July 27, July 30, August 1, August 3, August 7, and August 10, 2018 were overlaid on satellite imagery to provide a visual analysis of whether smoke emitted from the fires may have impacted ambient O_3 concentrations at the Paradise-4405 Airport Road monitoring site.[33] Additional HYSPLIT forward trajectories for each wildfire, including the Mendocino Complex (i.e., Ranch and River), Carr, Donnell, Ferguson, and Natchez fires, during the time period of the event were included in Appendix IV.[34] The back trajectories from the Paradise-4405 Airport Road monitoring site pass through areas of heavy to moderate smoke and occasionally near the fire locations, while the forward trajectories approach the monitoring site. Taken together, the forward trajectory analyses from the fires and the back-trajectories from Paradise support that wildfire emissions were transported to the Paradise-4405 Airport Road monitoring site on the days requested for exclusion as exceptional events.

Evidence that the wildfire emissions affected the monitor

The demonstration provided evidence that once wildfire emissions arrived at the Paradise-4405 Airport Road monitoring site, they impacted the O_3 data. The demonstration provides the 1-hour O_3 and $PM_{2.5}$ concentrations for July 15 to August 15, 2018, in Figure 3-30.[35] Concentrations of $PM_{2.5}$ increase significantly on July 26th and remain elevated until August 11th. All O_3 exceedance dates occurred during this period of elevated $PM_{2.5}$ concentrations. The strong correlation between elevated $PM_{2.5}$ and O_3 concentrations during the time of actively burning wildfires in the area support that wildfire emissions impacted the Paradise monitoring station.

Figures 4-15 through 4-25 in the demonstration show the percentiles for seasonal 1-hour O_3 concentrations for 2013-2017 compared with each day of the event. Although there are only slight deviations compared to the typical daily diurnal pattern, for most event days the majority of 1-hour O_3 concentrations are consistently higher than the 95th percentile, with peak O_3 concentrations well above the 95th.[36] The 8-hour design values and annual 4th highs for the Paradise site for 2009 to 2020 were also included.[37] The demonstrations states that the trend line for both sets of data show a gradual decrease over time, with the higher 2018 data due to the higher O_3 measurements.

The demonstration also included black carbon and biomass burning indicator analyses. Figure 4-70 of the demonstration showed the concentrations of three biomass burning indicators (levoglucosan, mannosan, and galactosan) measured at Portola, Chico, and Sacramento from July 1 to August 31, 2018. Although these sites do not consistently monitor during the summer months, they were active during the summer of 2018.[38] The two samples collected during the time addressed in this demonstration, on July 31st and August 6th of 2018, show concentrations across all three sites that are among the highest concentrations measured during the period in the figures. Elevated concentrations of these biomass burning indicators during the time of the requested exceptional event supports the presence of wildfire smoke in the area. The demonstration also included a map of black carbon smoke plumes associated with the Carr,

[33] See demonstration, pp. 44, 47, 50, 54, 57, 60.
[34] See demonstration, Appendix IV, pp. 241-307.
[35] See demonstration, pp. 63-65.
[36] See demonstration pp. 109-114.
[37] See demonstration p. 65.
[38] See demonstration, pp. 138-139.

Mendocino, and Ferguson Fires, and noted that wildfires are a major source of black carbon emissions in California.[39] The map shows high concentrations of atmospheric black carbon at the Mendocino Complex and Carr Fires surrounding Chico (Paradise) which supports evidence of wildfire smoke reaching the Paradise monitoring site during the time of the exceedances.

As additional evidence to support that wildfire emissions affected the Paradise-4405 Airport Road monitoring site, the demonstration included a selection of NOAA's Smoke Text Products, which give an overview of smoke origins, current location, and potential transport from satellite imagery.[40] Examples of media coverage and public health alerts from the summer of 2018 further illustrate that wildfire emissions were influencing the people and ground level conditions in Paradise.[41] The reports are consistent with the narratives stating that large areas of the western U.S., including Butte County, were impacted by wildfires in July and August 2018.

Conclusion

The analyses included in the demonstration, specifically comparison to historical concentrations, Tier 2 Key Factors including Q/D analyses, HYSPLIT modeling and satellite observations of smoke, correlation between $PM_{2.5}$ and O_3 during the event dates, evidence of impacts to hourly O_3 data, presence of biomass burning tracers, and related NWS and NOAA statements on smoke, sufficiently demonstrate a clear causal relationship between the emissions generated by multiple wildfires burning in the Northern California, namely the Ranch, River, Carr, Donnell, Ferguson, and Natchez, and the Taylor Creek and Klondike fires in Southern Oregon and the exceedances measured at Paradise-4405 Airport Road monitoring site.

Table 3: Documentation of the Clear Causal Relationship criterion

Exceedance Date	**Demonstration Citation**	**Quality of Evidence**	**Criterion Met?**
July 26-28, 2018 July 30-August 2, 2018 August 7-10, 2018	"Narrative Conceptual Model": pp.63-65, 80-82 "Clear Causal Relationship": pp. 84, 86, 92-95, 95-100 109-114, 138-141 Appendix II-B: pp. 172-178 Appendix IV: pp. 241-307, 310-313 Appendix V: pp. 327-338	Sufficient	Yes

Not Reasonably Controllable or Preventable

The Exceptional Events Rule presumes that wildfire events on wildland are not reasonably controllable or preventable [40 CFR §50.14(b)(4)]. The demonstration provided evidence that the wildfire event meets definition of wildfire [40 CFR §50.1(n)]. Specifically, the demonstration included maps and descriptions of the wildfires, along with figures showing wildfire boundaries overlaid upon land ownership and wildland-urban interface layers to demonstrate that the fires occurred on wildland or in the urban/wildland interface.[42] The demonstration described that CARB is not aware of any evidence clearly demonstrating that prevention or control efforts beyond those actually made would have been reasonable.[43] Therefore, the documentation

[39] See demonstration, pp. 140-141.
[40] See demonstration, Appendix V, pp. 327-338.
[41] See demonstration, pp. 80-82, Appendix II-B pp. 173-178.
[42] See demonstration, pp. 27-40.
[43] See demonstration, p. 145.

provided sufficiently demonstrates that the event was not reasonably controllable and not reasonably preventable.

Table 4: Documentation of the Not Reasonably Controllable or Preventable criterion

Exceedance Date	Demonstration Citation	Quality of Evidence	Criterion Met?
July 26-28, 2018 July 30-August 2, 2018 August 7-10, 2018	"Narrative Conceptual Model, Part I": pp. 27-40 "Not Reasonably Controllable and/or Not Reasonably Preventable": p. 145	Sufficient	Yes

Natural Event

The definition of "wildfire" at 40 CFR §50.1(n) states, "A wildfire that predominantly occurs on wildland is a natural event." As previously described, the demonstration included documentation that the event meets the definition of a wildfire and occurred predominantly on wildland and has therefore shown that the event was a natural event.

Table 5: Documentation of the Natural Event criterion

Exceedance Date	Demonstration Citation	Quality of Evidence	Criterion Met?
July 26-28, 2018 July 30-August 2, 2018 August 7-10, 2018	**"**Narrative Conceptual Model, Part I": pp. 27-40 "Natural Event/Human Activity Unlikely to Recur": p. 145	Sufficient	Yes

Schedule and Procedural Requirements

In addition to technical demonstration requirements, 40 CFR §50.14(c) and 40 CFR §51.930 specify schedule and procedural requirements an air agency must follow to request data exclusion. Table 6 outlines the EPA's evaluation of these requirements.

Table 6: Schedules and Procedural Criteria

	Reference	Demonstration Citation	Criterion Met?
Did the agency provide prompt public notification of the event?	40 CFR §50.14 (c)(1)(i)	"Narrative Conceptual Model – July 26-August 10, 2018": pp. 79-70 Appendix II- B: pp. 173-178.	Yes
Did the agency submit an Initial Notification of Potential Exceptional Event and flag the affected data in the EPA's Air Quality System (AQS)?	40 CFR §50.14 (c)(2)(i)	Appendix I-B: pp. 152-155	Yes

	Reference	Demonstration Citation	Criterion Met?
Did the initial notification and demonstration submittals meet the deadlines for data influenced by exceptional events for use in initial area designations, if applicable? Or the deadlines established by the EPA during the Initial Notification of Potential Exceptional Events process, if applicable?	40 CFR §50.14 Table 2 40 CFR §50.14 (c)(2)(i)(B)	Letter from Gwen Yoshimura, EPA R9, to Sylvia Vanderspek, CARB, dated August 27, 2021	Yes
Was the public comment process followed and documented? • Did the agency document that the comment period was open for a minimum of 30 days? • Did the agency submit to the EPA any public comments received? • Did the state address comments disputing or contradicting factual evidence provided in the demonstration?	40 CFR §50.14 (c)(3)(v)	Letter from Michael Benjamin, CARB, to Elizabeth Adams, EPA R9, dated October 28, 2021	Yes
Has the agency met requirements regarding submission of a mitigation plan, if applicable?	40 CFR §51.930 (b)	N/A	N/A

Conclusion

The EPA has reviewed the documentation provided by CARB to support claims that smoke from wildfires in Northern California and Southern Oregon caused exceedances of the 2015 8-hour O_3 NAAQS at Paradise-4405 Airport Road on July 26-28, July 30-August 2, and August 7-10, 2018. The EPA has determined that the flagged exceedances at this monitoring site on these days satisfy the exceptional event criteria: the event was a natural event, which affected air quality in such a way that there exists a clear causal relationship between the event and the monitored exceedances and was not reasonably controllable or preventable. The EPA has also determined that CARB has satisfied the schedule and procedural requirements for data exclusion.

ENCLOSURE: TECHNICAL SUPPORT DOCUMENT FOR EPA CONCURRENCE ON O_3 EXCEEDANCES MEASURED IN SUTTER BUTTES, CALIFORNIA ON JULY 28-AUGUST 1, AUGUST 3, AUGUST 7, AND AUGUST 9-10, 2018 AS AN EXCEPTIONAL EVENT

On September 17, 2021, the California Air Resources Board (CARB) submitted an exceptional event demonstration for nine exceedances of the 2015 8-hour ozone (O_3) National Ambient Air Quality Standards (NAAQS) of 0.070 parts per million (ppm) that occurred at the Sutter Buttes monitoring site on July 28-August 1, August 3, August 7, and August 9-10, 2018.[1] The demonstration submitted by CARB described that the nine exceedances measured between July 28 and August 10, 2018 were caused by multiple wildfires burning in Northern and Central California, namely, the Carr Fire in Shasta County, the Mendocino Complex Fire in areas of Colusa, Glenn, Lake and Mendocino counties, and the Donnell Fire in Tuolumne County.[2] Under the Exceptional Events Rule, air agencies can request the exclusion of event-influenced data, and the EPA can agree to exclude these data, from the data set used for certain regulatory decisions. The remainder of this document summarizes the Exceptional Events Rule requirements, the event and the EPA's review process.

EXCEPTIONAL EVENTS RULE REQUIREMENTS

The EPA promulgated the Exceptional Events Rule in 2007, pursuant to the 2005 amendment of Clean Air Act (CAA) Section 319. In 2016, the EPA finalized revisions to the Exceptional Events Rule. The 2007 Exceptional Events Rule and 2016 Exceptional Events Rule revisions added sections 40 CFR §50.1(j)-(r); §50.14; and §51.930 to title 40 of the Code of Federal Regulations (CFR). These sections contain definitions, criteria for EPA approval, procedural requirements, and requirements for air agency demonstrations. The EPA reviews the information and analyses in the air agency's demonstration package using a weight of evidence approach and decides to concur or not concur. The demonstration must satisfy all of the Exceptional Events Rule criteria for the EPA to concur with excluding the air quality data from regulatory decisions.

Under 40 CFR §50.14(c)(3)(iv), the air agency demonstration to justify exclusion of data must include:

A. "A narrative conceptual model that describes the event(s) causing the exceedance or violation and a discussion of how emissions from the event(s) led to the exceedance or violation at the affected monitor(s);"

B. "A demonstration that the event affected air quality in such a way that there exists a clear causal relationship between the specific event and the monitored exceedance or violation;"

[1] "Exceptional Events Demonstration for Ozone Exceedances; Northern California; July-August 2018 Wildfire Events," California Air Resources Board (September 17, 2021) ("demonstration"). The demonstration addresses multiple events and exceedances measured in Northern California in July – August 2018. The EPA's evaluation of the information presented in the demonstration is reflected in seven separate TSDs, grouped by nonattainment area affected.
[2] See demonstration, pp. 65-66.

C. "Analyses comparing the claimed event-influenced concentration(s) to concentrations at the same monitoring site at other times" to support requirement (B) above;

D. "A demonstration that the event was both not reasonably controllable and not reasonably preventable;" and

E. "A demonstration that the event was a human activity that is unlikely to recur at a particular location or was a natural event."[3]

In addition, the air agency must meet several procedural requirements, including:

1. submission of an Initial Notification of Potential Exceptional Event and flagging of the affected data in the EPA's Air Quality System (AQS) as described in 40 CFR §50.14(c)(2)(i),

2. completion and documentation of the public comment process described in 40 CFR §50.14(c)(3)(v), and

3. implementation of any relevant mitigation requirements as described in 40 CFR §51.930.

For data influenced by exceptional events to be excluded from use in initial area designations, air agencies must also meet the initial notification and demonstration submission deadlines specified in Table 2 to 40 CFR §50.14. We include below a summary of the Exceptional Events Rule criteria, including those identified in 40 CFR §50.14(c)(3)(iv).

Regulatory Significance

The 2016 Exceptional Events Rule includes regulatory language that applies the provisions of CAA section 319 to a specific set of regulatory actions. As identified in 40 CFR §50.14(a)(1)(i), these regulatory actions include initial area designations and redesignations; area classifications; attainment determinations (including clean data determinations); attainment date extensions; findings of State Implementation Plan (SIP) inadequacy leading to a SIP call; and other actions on a case-by-case basis as determined by the Administrator. Air agencies and the EPA should discuss the regulatory significance of an exceptional events demonstration during the Initial Notification of Potential Exceptional Event prior to the air agency submitting a demonstration for the EPA's review.

Narrative Conceptual Model

The 2016 Exceptional Events Rule directs air agencies to submit, as part of the demonstration, a narrative conceptual model of the event that describes and summarizes the event in question and provides context for analyzing the required statutory and regulatory technical criteria. Air agencies may support the narrative conceptual model with summary tables or maps. For wildfire O_3 events, the EPA recommends that the narrative conceptual model also discuss the interaction

[3] A natural event is further described in 40 CFR 50.1(k) as "an event and its resulting emissions, which may recur at the same location, in which human activity plays little or no direct causal role. For purposes of the definition of a natural event, anthropogenic sources that are reasonably controlled shall be considered to not play a direct role in causing emissions."

of emissions, meteorology, and chemistry of event and non-event O_3 formation in the area, and, under 40 CFR §50.14(a)(1)(i), must describe the regulatory significance of the proposed data exclusion.

Clear Causal Relationship and Supporting Analyses

The EPA considers a variety of evidence when evaluating whether there is a clear causal relationship between a specific event and the monitored exceedance or violation. For wildfire O_3 events, air agencies should compare the O_3 data requested for exclusion with seasonal and annual historical concentrations at the air quality monitor to establish a clear causal relationship between the event and monitored data. In addition to providing this information on the historical context for the event-influenced data, air agencies should further support the clear causal relationship criterion by demonstrating that the wildfire's emissions were transported to the monitor, that the emissions from the wildfire influenced the monitored concentrations, and, in some cases, air agencies may need to provide evidence of the contribution of the wildfire's emissions to the monitored O_3 exceedance or violation.

For wildfire O_3 events, the EPA has published a guidance document that provides three different tiers of analyses that apply to the "clear causal relationship" criterion within an air agency's exceptional events demonstration.[4] This tiered approach recognizes that some wildfire events may be more clear and/or extreme and, therefore, require relatively less evidence to satisfy the rule requirements. If a wildfire/O_3 event satisfies the key factors for either Tier 1 or Tier 2 clear causal analyses, then those analyses are the only analyses required to support the clear causal relationship criterion within an air agency's demonstration for that particular event. Other wildfire/O_3 events will be considered based on Tier 3 analyses.

- Tier 1: Wildfires that clearly influence monitored O_3 exceedances or violations when they occur in an area that typically experiences lower O_3 concentrations.
    - *Key Factor*: seasonality and/or distinctive level of the monitored O_3 concentration. The event-related exceedance occurs during a time of year that typically has no exceedances, or is clearly distinguishable (*e.g.*, 5-10 parts per billion (ppb) higher) from non-event exceedances.
    - In these situations, O_3 impacts should be accompanied by clear evidence that the wildfire's emissions were transported to the location of the monitor.

- Tier 2: The wildfire event's O_3 influences are higher than non-event related concentrations, and fire emissions compared to the fire's distance from the affected monitor indicate a clear causal relationship.
    - *Key Factor 1*: fire emissions and distance of fire(s) to affected monitoring site location(s). Calculated fire emissions of nitrogen oxides (NO_x) and reactive-volatile organic compounds (VOC) in tons per day (Q) divided by the distance from the fire to the monitoring site (D) should be equal to or greater than 100 tons per day/kilometers ($Q/D \geq 100$ tpd/km). The guidance document provides additional information on the calculation of Q/D.

[4] "Guidance on the Preparation of Exceptional Events Demonstrations for Wildfire Events that May Influence Ozone Concentrations" (September 2016) ("wildfire O_3 guidance document").

- *Key Factor 2*: comparison of the event-related O_3 concentration with non-event related high O_3 concentrations. The exceedance due to the exceptional event:
  - is in the 99th or higher percentile of the 5-year distribution of O_3 monitoring data, OR
  - is one of the four highest O3 concentrations within 1 year (among those concentrations that have not already been excluded under the Exceptional Events Rule, if any).
- In addition to the analysis required for Tier 1, the air agency should supply additional evidence to support the weight of evidence that emissions from the wildfire affected the monitored O_3 concentration.

- Tier 3: The wildfire does not fall into the specific scenarios (i.e. does not meet the key factors) that qualify for Tier 1 or Tier 2, but the clear causal relationship criterion can still be satisfied by a weight of evidence showing.
  - In addition to the analyses required for Tier 1 and Tier 2, an air agency may further support the clear causal relationship with additional evidence that the fire emissions caused the O_3 exceedance.

Not Reasonably Controllable or Preventable

The Exceptional Events Rule requires that air agencies establish that the event be both not reasonably controllable and not reasonably preventable at the time the event occurred. This requirement applies to both natural events and events caused by human activities; however, it is presumed that wildfires on wildland will satisfy both factors of the "not reasonably controllable or preventable" element unless evidence in the record clearly demonstrates otherwise.[5]

Natural Event

According to the CAA and the Exceptional Events Rule, an exceptional event must be "an event caused by human activity that is unlikely to recur at a particular location *or* a natural event" (emphasis added). The 2016 Exceptional Events Rule includes in the definition of wildfire that "[a] wildfire that predominantly occurs on wildland is a natural event." Once an agency provides evidence that a wildfire on wildland occurred and demonstrates that there is a clear causal relationship between the measurement under consideration and the event, the EPA expects minimal documentation to satisfy the "human activity that is unlikely to recur at a particular location or a natural event" element. The EPA will address wildfires on other lands on a case-by-case basis.

EPA REVIEW OF EXCEPTIONAL EVENTS DEMONSTRATION

On March 16, 2021, CARB submitted an Initial Notification of a potential Exceptional Event for 10 exceedances of the 2015 8-hour O_3 NAAQS that occurred at the Sutter Buttes monitoring site

[5] A wildfire is defined in 40 CFR 50.1(n) as "any fire started by an unplanned ignition caused by lightning; volcanoes; other acts of nature; unauthorized activity; or accidental, human-caused actions, or a prescribed fire that has developed into a wildfire. A wildfire that predominantly occurs on wildland is a natural event." Wildland is defined in 40 CFR 50.1(o) as "an area in which human activity and development are essentially non-existent, except for roads, railroads, power lines, and similar transportation facilities. Structures, if any, are widely scattered."

within Sutter County, CA between July and August 2018.[6] On September 17, 2021, CARB submitted an exceptional event demonstration for nine exceedances of the 2015 O_3 NAAQS that occurred at the Sutter Buttes monitoring site within Sutter County, CA between July 28, and August 10, 2018.[7]

Regulatory Significance

The EPA determined that data exclusion of some of the exceedances referenced in the Initial Notification may have a regulatory significance for the determination of attainment by the attainment date for the Sutter Buttes, California Marginal nonattainment area for the 2015 O_3 NAAQS and worked with CARB to identify the relevant exceedances and monitoring site affected.[8] Table 1 summarizes the exceedances measured at the Sutter Buttes monitoring site that CARB included in the demonstration.

Table 1: 2015 O_3 NAAQS Exceedance Summary

Exceedance Date	Monitoring Site Name	AQS ID	8-hour Avg. (ppm)
July 28, 2018	Sutter Buttes	06-101-0004	0.080
July 29, 2018	Sutter Buttes	06-101-0004	0.075
July 30, 2018	Sutter Buttes	06-101-0004	0.083
July 31, 2018	Sutter Buttes	06-101-0004	0.082
August 1, 2018	Sutter Buttes	06-101-0004	0.082
August 3, 2018	Sutter Buttes	06-101-0004	0.074
August 7, 2018	Sutter Buttes	06-101-0004	0.075
August 9, 2018	Sutter Buttes	06-101-0004	0.079
August 10, 2018	Sutter Buttes	06-101-0004	0.077

Narrative Conceptual Model

The demonstration submitted by CARB provided a narrative conceptual model in the "Overview/Introduction," "Background," and "Narrative Conceptual Model – July 26-August 10, 2018" sections of the demonstration to describe how emissions from the Carr Fire, the Mendocino Complex Fire, and the Donnell Fire caused the O_3 exceedances at the Sutter Buttes monitoring site.[9] The narrative conceptual model addressed the regulatory significance of the exceptional event by stating that the exclusion of wildfire events in 2018 and 2020 would affect a determination of attainment for the Sutter Buttes, CA nonattainment area for the 2015 O_3 NAAQS.[10]

The demonstration also presented background information, including a description of California's geographically-divided air basins, local topographical information showing the unique positioning of the Sutter Buttes monitoring site at the top of the South Buttes in the Sutter

[6] See email from Sylvia Vanderspek, CARB, to Gwen Yoshimura, EPA Region 9, dated March 16, 2021.
[7] See letter from Michael Benjamin, CARB, to Elizabeth Adams, EPA Region 9, dated September 17, 2021.
[8] See letter from Elizabeth Adams, EPA Region 9, to Sylvia Vanderspek, dated August 27, 2021.
[9] See demonstration, pp. 65-66.
[10] See demonstration, pp. 2-5.

Buttes Mountain Range (which reaches an elevation of 2,115 feet) to measure high elevation pollutant transport, and typical summertime meteorological conditions.[11] Furthermore, the background information included in the demonstration provided general descriptions of California's ambient air monitoring network as well as characteristics of non-event O_3 formation.[12]

The narrative conceptual model included a description of all wildfires that were active during the period of interest between July 26 and August 10, 2018, with daily and total acreage burned.[13] An overview of characteristics of event O_3 formation associated with wildfire emissions is included in the demonstration.[14] To highlight the presence of wildfire smoke, the narrative conceptual model incorporates Moderate Resolution Imaging Spectroradiometer (MODIS) Aqua visible satellite imagery and smoke layers from the National Oceanic and Atmospheric Administration (NOAA) Hazard and Mapping System (HMS) Fire and Smoke Product for selected days throughout the period of interest.[15] The aforementioned MODIS imagery and HMS smoke layers included in the demonstration show heavy smoke pervading the Sacramento Valley Air Basin (in which the Sutter Buttes monitoring site is located) on multiple days between July 26 and August 10, 2018, primarily from the nearby Mendocino Complex and Carr fires.

Additionally, the demonstration included both a discussion of the synoptic scale meteorology over the course of the 14-day period in which the nine submitted exceedance events occurred as well as forward and backward Hybrid Single Particle Lagrangian Integrated Trajectory (HYSPLIT) modeling showing transport of wildfire smoke.[16] The narrative conceptual model described how the HYSPLIT back trajectories show the likely paths that air parcels traveled toward air quality monitors preceding the hour of peak O_3 concentration while the forward trajectories show the likely path that parcels of air traveled from their originating point at each major fire.[17] Maximum daily temperatures and wind speeds were provided for all days between July 26, 2018 and August 10, 2018, including for all nine days that were characterized as exceptional event days. The demonstration noted that these meteorological data suggest that unusual weather was not a factor contributing to the exceptional event besides through transport.[18] Furthermore, the narrative conceptual model provided media coverage documenting the impact of the event, showing both national coverage as well as local social media coverage from the Feather River Air Quality Management District (AQMD), the local air quality district for Sutter and Yuba counties.[19] Finally, the narrative conceptual model included a copy of an air quality health advisory issued by the Feather River AQMD on July 26, 2018, to notify the public of smoke impacts that were anticipated to continue for several days from the time of the advisory.[20]

[11] See demonstration, pp. 10, 13-14.
[12] See demonstration, pp. 17-19, 22, 26.
[13] See demonstration, pp. 27-40.
[14] See demonstration, p. 26.
[15] See demonstration, pp. 44-45, 47-48, 50-51, 54-55, 57-58, 60-61.
[16] See demonstration, pp. 40-61.
[17] See demonstration, pp. 40-42.
[18] See demonstration, pp. 74, 76.
[19] See demonstration, pp. 81-82.
[20] See demonstration, Appendix II, pp. 179-180.

The demonstration provided a discussion of the event-related O_3 concentrations and long-term trends at the Sutter Buttes monitoring site as part of the narrative conceptual model.[21] Specifically, the narrative conceptual model included time series data showing non-event concentrations of O_3 and particulate matter less than or equal to 2.5 microns ($PM_{2.5}$) both preceding and following the event period as well as concurrently elevated O_3 and $PM_{2.5}$ concentrations during the event period.[22]

Based on the information described above, the demonstration submitted by CARB meets the narrative conceptual model criterion of the Exceptional Events Rule (EER).

Table 2: Documentation of the Narrative Conceptual Model

Exceedance Date	**Demonstration Citation**	**Quality of Evidence**	**Criterion Met?**
July 28-August 1, August 3, August 7, August 9-10, 2018	"Overview/Introduction": pp. 2-5 "Background": pp. 10, 13-14, 17-19, 22, 26 "Narrative Conceptual Model": pp. 27-61, 65-66, 74, 76, 81-82 Appendix II-C: pp. 179-180	Sufficient	Yes

Clear Causal Relationship

The demonstration included several analyses to support a clear causal relationship between the wildfire event and the monitored exceedances. These analyses are presented in the section of the demonstration titled "Clear Causal Relationship" which presents evidence for Tier 1 in subsection I and for Tier 2 in subsections II and III. Additional information regarding transport of wildfire smoke to the Sutter Buttes monitoring site and timeseries data of O_3 and $PM_{2.5}$ concentrations in the area between July 15 and August 15 were included in subsections II and III.C, respectively, of the narrative conceptual model.

Comparison with historical concentrations

The demonstration included a comparison with historical concentrations, as required by 40 CFR §50.14(c)(3)(iv)(C). The demonstration compared event-related O_3 concentrations with historical non-event 8-hour daily O_3 maximum concentrations between 2013 and 2018. This included a graph of daily maximum 8-hour average concentrations over the six-year period by day of year along with the level of the NAAQS and the 99th percentile value (0.079 ppm) at this site.[23] The graph shows that the exceptional event occurred during the time of year where O_3 concentrations tend to be higher at this monitoring site and that the exceptional event exceedances at the Sutter Buttes monitoring site are not clearly distinguishable from non-event exceedances as defined by guidance.[24]

Tier 1: Key Factor

To meet the key factor for a Tier 1 analysis, exceedances should be clearly higher than other non-event related exceedances or occur during a time of year that typically experiences no exceedances. The exceedances identified in this demonstration occurred during the typical O_3

[21] See demonstration, pp. 65-67.
[22] See demonstration, p. 66.
[23] See demonstration, p. 87.
[24] See demonstration, pp. 83-84, 87.

season during times when other exceedances similar in magnitude were measured, and do not exceed non-event concentrations by at least 5 ppb. Therefore, the exceedances do not meet the Tier 1 Key Factor, and additional evidence beyond a Tier 1 analysis is needed to support the clear causal relationship.

Tier 2: Key Factors

The demonstration included an evaluation of the Tier 2 Key Factors. For Tier 2 Key Factor 1, the demonstration provided an analysis of fire emissions (Q) and distance (D) of the wildfires to the monitoring site locations. The Q/D value is generally calculated by dividing wildfire emissions (in tons per day) by the distance between the wildfire and the monitoring site (in kilometers [km]). Daily Q/D values were calculated by the EPA using daily wildland fire emissions input files originally created for the Community Multiscale Air Quality (CMAQ) modeling system. The resulting calculations were shared with CARB to assist in demonstration development. CMAQ input files included daily total emissions of nitrogen oxide, nitrogen dioxide, and reactive organic gases at release points corresponding to wildfire locations. Q/D was calculated for each CMAQ input release point by calculating the distance between release point locations and gridded receptor locations and dividing the associated fire's daily total emissions by this distance. An aggregated daily Q/D was then calculated by summing the individual Q/D values for each release point. An "effective Q/D" value was then calculated at monitoring site receptor locations by accounting for periods where multiple days of wildfire smoke buildup impacted the monitoring site for up to three total days; the dates to include in each daily "effective Q/D" were based on meteorology and transport analyses, with the rationale further outlined in the demonstration.[25] The distance-weighted sums for all dates requested as exceptional events at the Sutter Buttes monitoring site except for August 10, 2018 are greater than the Tier 2 Key Factor 1 screening value of 100 tons per day of NO_X and VOC per km.[26] Therefore, the event exceedances for all dates except for August 10, 2018, meet Tier 2 Key Factor 1. The demonstration described that enhanced wildfire impacts for August 10, 2018, are also considered qualifying because they occurred at the end of a prolonged event, wildfire emissions were decreasing but remained elevated, and residual local effects continued to impact O_3 concentrations at the monitoring site.[27] Since all of the dates but one meet Tier 2 Key Factor 1, and the date that does not meet Tier 2 Key Factor 1 follows several days of requested exclusions that do meet the key factor, it is appropriate to consider all days included in the demonstration as meeting Tier 2 Key Factor 1 for the purposes of determining the appropriate tier for this demonstration.

For Tier 2 Key Factor 2, the demonstration included evidence that the exceedances, including August 10, 2018, are at or above the 99th percentile from the past five years of O_3 season data (January-December 2013-2017) or are among the adjusted four highest concentrations measured at the site in 2018. In the demonstration, CARB determined an "adjusted 4th high" corresponding to the 4th highest non-event exceedance monitored in 2018, excluding the exceedances included in the demonstration.[28] CARB stated that dates impacted by exceptional events should not count against the tally of the four highest O_3 concentrations measured in 2018 because these

[25] See demonstration, pp. 92-93, 95-96.
[26] See demonstration, pp. 95-96.
[27] See demonstration, p. 95.
[28] See demonstration, pp. 98-100.

exceedances were caused by contributions from wildfire emissions.[29] This rationale is supported given that the purpose of the test is to show that the exceedances are high compared to non-event data. Since the excluded dates are all included in the demonstration being evaluated in this technical support document, each individual date would not count towards the four highest concentrations if concurred on by the EPA. Table 4-8 presented the 20 highest daily 8-hour O_3 concentrations at the Sutter Buttes monitoring site and showed that all the requested event dates, including August 10, 2018, exceeded an adjusted 4th highest concentration of 0.072 ppm if the exceptional event dates being requested are excluded.[30] Furthermore, the demonstration showed that five of the nine requested dates, namely July 28, July 30-August 1, and August 9, 2018, all have maximum daily concentrations at or above the 99th percentile concentration of 0.079 ppm. Therefore, the event exceedances meet Tier 2 Key Factor 2.

Based on the analysis of the Key Factors for Tier 2, the EPA's wildfire O_3 guidance document indicates that a Tier 2 analysis is appropriate for this event. As described below, the demonstration included the required elements for a Tier 2 clear causal relationship analysis based on the EPA's wildfire O_3 guidance document. This includes evidence to support that (1) wildfire emissions were transported from the wildfire to the monitor; and (2) wildfire emissions affected the monitor.

Evidence of transport of wildfire emissions from the wildfire to the monitor

The demonstration presented several data sources as evidence of transport of wildfire emissions from the wildfires to the Sutter Buttes monitoring site. The narrative conceptual model provided figures of HYSPLIT back trajectories initiated from the monitor location showing the likely path or air parcels for 36 hours prior to the time of peak concentrations on July 30, August 1, August 3, August 7, and August 10, 2018 at three elevations (100 meters (m), 500 m, and 1000 m) overlaid on NOAA HMS Fire and Smoke Product Imagery.[31] The demonstration's Appendix IV continues with an analysis of back trajectories tracing the path emissions took from the Sutter Buttes monitoring site during the event period (not overlaid on a smoke map). The demonstration listed each exceedance date and identified the first hour of the exceeding 8-hour time-period and the maximum hour within that 8-hout time period.[32]

HYSPLIT forward trajectories showing the most likely center path of air parcels for 36 hours beginning at the wildfire location on July 30, August 1, August 3, August 7, and August 10, 2018 were overlaid on satellite imagery to provide a visual analysis of whether smoke emitted from the fires may have impacted ambient O_3 concentrations at the Sutter Buttes monitoring site.[33] Additional HYSPLIT forward trajectories showing transport from each active fire including the Carr, Mendocino Complex, and Donnell fires during the time-period of the event were included in Appendix IV.[34] The back trajectories from the Sutter Buttes monitoring site pass through the areas of the Carr, Mendocino Complex, and Butte fires on numerous days in the event period. The forward trajectory paths for the Carr fire on July 26, 2018, the Ranch fire on July 27, August 3-5, and August 10, 2018, and the River fire on July 27 and July 31-August 6, 2018 pass through

[29] See demonstration, p. 99.
[30] See demonstration, pp. 100-101.
[31] See demonstration, pp. 48, 51, 55, 58, 61.
[32] See demonstration, Appendix IV, pp. 314-316.
[33] See demonstration, pp. 47, 50, 54, 57, 60.
[34] See demonstration, Appendix IV, pp. 241-306.

the Sutter Buttes area. Forward trajectory paths from the Butte fire pass through the area of the Sutter Buttes monitoring site on most days evaluated due to the proximity of the monitoring site to the Butte fire. Taken together, the forward trajectory analyses from the fires and the back trajectories from the Sutter Buttes monitoring site support that wildfire emissions were transported to the Sutter Buttes monitoring site on the days requested for exclusion as exceptional events.

In addition to the forward and back trajectory analyses, the demonstration provided an analysis of synoptic scale meteorology in the narrative conceptual model and included, among other fields, surface and upper level weather analyses for select days during the event period to show the mechanism of transport of emissions.[35] Additional synoptic-scale weather analyses were included in Appendix III of the demonstration.[36] The discussion of meteorological conditions showed favorable conditions for continued fire development as well as transport and pooling of emissions in the Sacramento Valley Air Basin on several days from July 26, 2018 to August 10, 2018.

Evidence that the wildfire emissions affected the monitor

The demonstration provided evidence that wildfire emissions affected the Sutter Buttes monitoring site, including Figure 3-33 showing hourly O_3 concentrations at the Sutter Buttes monitoring site and $PM_{2.5}$ concentrations at the nearby Yuba City-Almond St. monitoring site between July 15, 2018, and August 15, 2018.[37] Figure 3-33 of the demonstration shows elevated $PM_{2.5}$ concentrations that are concurrent with elevated O_3 concentrations at the Sutter Buttes monitoring site in the period between July 28 and August 10, 2018, during which the nine requested exceptional event dates occurred. The demonstration also showed $PM_{2.5}$ concentrations in general to be elevated over the event period in the Sacramento Valley Air Basin.[38]

Section III of the "Clear Causal Relationship" chapter of the demonstration included diurnal profiles of O_3 concentrations at the Sutter Buttes monitoring site for each submitted exceptional event date compared with seasonal percentiles from 2013-2017 in Figures 4-26 through 4-34.[39] All exceedance days show an atypical late evening/end of day peak above the 95th percentile; from July 28 through July 30, the diurnal pattern also shows an unusual mid-day dip.

The demonstration presented additional evidence of wildfire emissions impacting the Sacramento Valley Air Basin through data showing enhanced concentrations of the biomass burning products of levoglucosan, mannosan, and galactosan at the Sacramento-T Street monitor (as well as Portola and Chico) between July 1 and August 31, 2018.[40] Although these sites do not consistently monitor during the summer months, they were active during the summer of 2018.[41] The two samples collected during the time addressed in this demonstration (July 31 and August 6, 2018) show concentrations across all three sites that are among the highest concentrations measured during the period in the figures. Elevated concentrations of these biomass burning indicators during the time of the requested exceptional event days support the presence of

[35] See demonstration, pp. 43, 46, 49, 53, 56, 59.
[36] See demonstration, Appendix III, pp. 215-223.
[37] See demonstration, p. 66.
[38] See demonstration, pp. 136-137.
[39] See demonstration, pp. 115-119.
[40] See demonstration, pp. 138-139.
[41] See demonstration, p. 138.

wildfire smoke in the area. Additionally, Figure 4-72 shows relatively large amounts of atmospheric black carbon in the area of the Sutter Buttes monitoring site, particularly near the Mendocino Complex fire, suggesting that wildfire smoke impacted the Sutter Buttes monitoring site.[42]

Excerpts from National Weather Service (NWS) area forecasts mentioning wildfire smoke impacts were included in Appendix III of the demonstration for each day between July 25 and August 10, 2018.[43] The demonstration also provided a special weather statement issued by the Sacramento NWS on August 4, 2018, in Appendix III of the demonstration, which included a notification to the public of dense smoke and falling ash in Northern and Central California from the Mendocino Complex and Carr fires.[44] Media reports were also included in Appendix VI of the demonstration including descriptions of air quality affected by wildfire smoke in Butte County, California, and photographs presented to show that smoke plumes reached the ground in the Sacramento Valley Air Basin on days during the event period.[45]

Conclusion

The analyses included in the demonstration, specifically the comparison to event-related O_3 concentrations to non-event historical O_3 concentrations, Tier 2 Key Factors including Q/D analyses, HYSPLIT trajectories, the evidence of elevated $PM_{2.5}$ concentrations, data showing elevated biomas burning products and black carbon, and related NWS and NOAA statements on smoke, sufficiently demonstrate a clear causal relationship between the emissions generated by multiple wildfires burning in Northern and Central California and the exceedances measured at the Sutter Buttes monitoring site.

Table 3: Documentation of the Clear Causal Relationship criterion

Exceedance Date	Demonstration Citation	Quality of Evidence	Criterion Met?
July 28-August 1, August 3, August 7, August 9-10, 2018	"Narrative Conceptual Model": pp. 27-66 "Clear Causal Relationship": pp. 96, 101, 115-116, 136-139, 140-143 Appendix II.: pp. 216-218 Appendix III: 222-228, 230-233, 236-238 Appendix IV.B: pp. 241-306, 314-316 Appendix V: pp. 339-373	Sufficient	Yes

Not Reasonably Controllable or Preventable

The Exceptional Events Rule presumes that wildfire events on wildland are not reasonably controllable or preventable [40 CFR §50.14(b)(4)]. The demonstration provided evidence that the wildfire event meets definition of wildfire [40 CFR §50.1(n)]. Specifically, the demonstration included maps and descriptions of the wildfires, along with figures showing wildfire boundaries overlaid upon land ownership and wildland-urban interface layers to demonstrate that the fires occurred on wildland or in the urban/wildland interface.[46] The demonstration described that CARB is not aware of any evidence clearly demonstrating that prevention or control efforts

[42] See demonstration, pp. 140-141.
[43] See demonstration, Appendix III, pp. 223-238.
[44] See demonstration, Appendix III, pp. 238-240.
[45] See demonstration, Appendix V, pp. 339-373.
[46] See demonstration, pp. 27-40.

beyond those actually made would have been reasonable.[47] Therefore, the documentation provided sufficiently demonstrates that the event was not reasonably controllable and not reasonably preventable.

Table 4: Documentation of the Not Reasonably Controllable or Preventable criterion

Exceedance Date	Demonstration Citation	Quality of Evidence	Criterion Met?
July 28-August 1, August 3, August 7, August 9-10, 2018	"Narrative Conceptual Model – July 26-August 10, 2018": pp. 27-40 "Not Reasonably Controllable and/or Not Reasonably Preventable": p. 145	Sufficient	Yes

Natural Event

The definition of "wildfire" at 40 CFR §50.1(n) states, "A wildfire that predominantly occurs on wildland is a natural event." As previously described, the demonstration included documentation that the event meets the definition of a wildfire and occurred predominantly on wildland and has therefore shown that the event was a natural event.

Table 5: Documentation of the Natural Event criterion

Exceedance Date	Demonstration Citation	Quality of Evidence	Criterion Met?
July 28-August 1, August 3, August 7, August 9-10, 2018	"Narrative Conceptual Model – July 26-August 10, 2018": pp. 27-40 "Natural Event/Human Activity Unlikely to Recur": p. 145	Sufficient	Yes

Schedule and Procedural Requirements

In addition to technical demonstration requirements, 40 CFR §50.14(c) and 40 CFR §51.930 specify schedule and procedural requirements an air agency must follow to request data exclusion. Table 6 outlines the EPA's evaluation of these requirements.

[47] See demonstration, p. 145.

Table 6: Schedules and Procedural Criteria

	Reference	Demonstration Citation	Criterion Met?
Did the agency provide prompt public notification of the event?	40 CFR §50.14 (c)(1)(i)	"Narrative Conceptual Model – July 26-August 10, 2018": pp. 79-80; Appendix II: pp. 179-180.	Yes
Did the agency submit an Initial Notification of Potential Exceptional Event and flag the affected data in the EPA's Air Quality System (AQS)?	40 CFR §50.14 (c)(2)(i)	Appendix I: pp. 156-157.	Yes
Did the initial notification and demonstration submittals meet the deadlines for data influenced by exceptional events for use in initial area designations, if applicable? Or the deadlines established by the EPA during the Initial Notification of Potential Exceptional Events process, if applicable?	40 CFR §50.14 Table 2 40 CFR §50.14 (c)(2)(i)(B)	Appendix I: pp. 156-157; Letter from Gwen Yoshimura, EPA R9, to Sylvia Vanderspek, CARB, dated August 27, 2021.	Yes
Was the public comment process followed and documented? • Did the agency document that the comment period was open for a minimum of 30 days? • Did the agency submit to the EPA any public comments received? • Did the state address comments disputing or contradicting factual evidence provided in the demonstration?	40 CFR §50.14 (c)(3)(v)	Letter from Michael Benjamin, CARB, to Elizabeth Adams, EPA R9, dated October 28, 2021.	Yes
Has the agency met requirements regarding submission of a mitigation plan, if applicable?	40 CFR §51.930 (b)	N/A	N/A

Conclusion

The EPA has reviewed the documentation provided by CARB to support claims that smoke from multiple wildfires in Northern and Central California, namely the Carr, Mendocino Complex, and Donnell fires, caused exceedances of the 2015 8-hour O_3 NAAQS at the Sutter Buttes monitoring site on July 28-August 1, 2018, August 3, 2018, August 7, 2018, and August 9-10, 2018. The EPA has determined that the flagged exceedances at this monitoring site on these days satisfies the exceptional event criteria: the event was a natural event, which affected air quality in such a way that there exists a clear causal relationship between the event and the monitored exceedances and was not reasonably controllable or preventable. The EPA has also determined that CARB has satisfied the schedule and procedural requirements for data exclusion.

ENCLOSURE: TECHNICAL SUPPORT DOCUMENT FOR EPA CONCURRENCE ON O_3 EXCEEDANCES MEASURED IN SUTTER BUTTES, CALIFORNIA ON AUGUST 21-22, 2020 AS AN EXCEPTIONAL EVENT

On November 19, 2021, the California Air Resources Board (CARB) submitted an exceptional event demonstration for exceedances of the 2015 8-hour ozone (O_3) National Ambient Air Quality Standards (NAAQS) of 0.070 parts per million (ppm) that occurred at the Sutter Buttes monitoring site on August 21-22, 2020.[1] The demonstration submitted by CARB stated that the exceedances measured on August 21-22, 2020 were caused by multiple wildfires burning in Northern and Central California, namely, the August Complex, North Complex, Woodward, LNU Lightning Complex, SCU Lightning, and CZU Lightning fires.[2] Under the Exceptional Events Rule, air agencies can request the exclusion of event-influenced data, and the EPA can agree to exclude these data, from the data set used for certain regulatory decisions. The remainder of this document summarizes the Exceptional Events Rule requirements, the event and the EPA's review process.

EXCEPTIONAL EVENTS RULE REQUIREMENTS

The EPA promulgated the Exceptional Events Rule in 2007, pursuant to the 2005 amendment of Clean Air Act (CAA) Section 319. In 2016, the EPA finalized revisions to the Exceptional Events Rule. The 2007 Exceptional Events Rule and 2016 Exceptional Events Rule revisions added sections 40 CFR §50.1(j)-(r); §50.14; and §51.930 to title 40 of the Code of Federal Regulations (CFR). These sections contain definitions, criteria for EPA approval, procedural requirements, and requirements for air agency demonstrations. The EPA reviews the information and analyses in the air agency's demonstration package using a weight of evidence approach and decides to concur or not concur. The demonstration must satisfy all of the Exceptional Events Rule criteria for the EPA to concur with excluding the air quality data from regulatory decisions.

Under 40 CFR §50.14(c)(3)(iv), the air agency demonstration to justify exclusion of data must include:

A. "A narrative conceptual model that describes the event(s) causing the exceedance or violation and a discussion of how emissions from the event(s) led to the exceedance or violation at the affected monitor(s);"

B. "A demonstration that the event affected air quality in such a way that there exists a clear causal relationship between the specific event and the monitored exceedance or violation;"

C. "Analyses comparing the claimed event-influenced concentration(s) to concentrations at the same monitoring site at other times" to support requirement (B) above;

[1] "Exceptional Events Demonstration for Ozone Exceedances Northern California 2020 Wildfire Events," (November 18, 2021) ("demonstration"). The demonstration also includes exceptional events analyses for other California nonattainment areas for the 2008 and/or 2015 NAAQS. The EPA's evaluation of the information presented in the demonstration is reflected in four separate technical support documents.

[2] See demonstration, pp. 21, 95.

D. "A demonstration that the event was both not reasonably controllable and not reasonably preventable;" and

E. "A demonstration that the event was a human activity that is unlikely to recur at a particular location or was a natural event."[3]

In addition, the air agency must meet several procedural requirements, including:

1. submission of an Initial Notification of Potential Exceptional Event and flagging of the affected data in the EPA's Air Quality System (AQS) as described in 40 CFR §50.14(c)(2)(i),

2. completion and documentation of the public comment process described in 40 CFR §50.14(c)(3)(v), and

3. implementation of any relevant mitigation requirements as described in 40 CFR §51.930.

For data influenced by exceptional events to be excluded from use in initial area designations, air agencies must also meet the initial notification and demonstration submission deadlines specified in Table 2 to 40 CFR §50.14. We include below a summary of the Exceptional Events Rule criteria, including those identified in 40 CFR §50.14(c)(3)(iv).

Regulatory Significance

The 2016 Exceptional Events Rule includes regulatory language that applies the provisions of CAA section 319 to a specific set of regulatory actions. As identified in 40 CFR §50.14(a)(1)(i), these regulatory actions include initial area designations and redesignations; area classifications; attainment determinations (including clean data determinations); attainment date extensions; findings of State Implementation Plan (SIP) inadequacy leading to a SIP call; and other actions on a case-by-case basis as determined by the Administrator. Air agencies and the EPA should discuss the regulatory significance of an exceptional events demonstration during the Initial Notification of Potential Exceptional Event prior to the air agency submitting a demonstration for the EPA's review.

Narrative Conceptual Model

The 2016 Exceptional Events Rule directs air agencies to submit, as part of the demonstration, a narrative conceptual model of the event that describes and summarizes the event in question and provides context for analyzing the required statutory and regulatory technical criteria. Air agencies may support the narrative conceptual model with summary tables or maps. For wildfire O_3 events, the EPA recommends that the narrative conceptual model also discuss the interaction of emissions, meteorology, and chemistry of event and non-event O_3 formation in the area, and,

[3] A natural event is further described in 40 CFR 50.1(k) as "an event and its resulting emissions, which may recur at the same location, in which human activity plays little or no direct causal role. For purposes of the definition of a natural event, anthropogenic sources that are reasonably controlled shall be considered to not play a direct role in causing emissions."

under 40 CFR §50.14(a)(1)(i), must describe the regulatory significance of the proposed data exclusion.

Clear Causal Relationship and Supporting Analyses

The EPA considers a variety of evidence when evaluating whether there is a clear causal relationship between a specific event and the monitored exceedance or violation. For wildfire O_3 events, air agencies should compare the O_3 data requested for exclusion with seasonal and annual historical concentrations at the air quality monitor to establish a clear causal relationship between the event and monitored data. In addition to providing this information on the historical context for the event-influenced data, air agencies should further support the clear causal relationship criterion by demonstrating that the wildfire's emissions were transported to the monitor, that the emissions from the wildfire influenced the monitored concentrations, and, in some cases, air agencies may need to provide evidence of the contribution of the wildfire's emissions to the monitored O_3 exceedance or violation.

For wildfire O_3 events, the EPA has published a guidance document that provides three different tiers of analyses that apply to the "clear causal relationship" criterion within an air agency's exceptional events demonstration.[4] This tiered approach recognizes that some wildfire events may be more clear and/or extreme and, therefore, require relatively less evidence to satisfy the rule requirements. If a wildfire/O_3 event satisfies the key factors for either Tier 1 or Tier 2 clear causal analyses, then those analyses are the only analyses required to support the clear causal relationship criterion within an air agency's demonstration for that particular event. Other wildfire/O_3 events will be considered based on Tier 3 analyses.

- Tier 1: Wildfires that clearly influence monitored O_3 exceedances or violations when they occur in an area that typically experiences lower O_3 concentrations.
    - *Key Factor*: seasonality and/or distinctive level of the monitored O_3 concentration. The event-related exceedance occurs during a time of year that typically has no exceedances, or is clearly distinguishable (*e.g.*, 5-10 parts per billion (ppb) higher) from non-event exceedances.
    - In these situations, O_3 impacts should be accompanied by clear evidence that the wildfire's emissions were transported to the location of the monitor.

- Tier 2: The wildfire event's O_3 influences are higher than non-event related concentrations, and fire emissions compared to the fire's distance from the affected monitor indicate a clear causal relationship.
    - *Key Factor 1*: fire emissions and distance of fire(s) to affected monitoring site location(s). Calculated fire emissions of nitrogen oxides (NO_x) and reactive-volatile organic compounds (VOC) in tons per day (Q) divided by the distance from the fire to the monitoring site (D) should be equal to or greater than 100 tons per day/kilometers ($Q/D \geq 100$ tpd/km). The guidance document provides additional information on the calculation of Q/D.

[4] "Guidance on the Preparation of Exceptional Events Demonstrations for Wildfire Events that May Influence Ozone Concentrations" (September 2016) ("wildfire O_3 guidance document").

- *Key Factor 2*: comparison of the event-related O_3 concentration with non-event related high O_3concentrations. The exceedance due to the exceptional event:
  - is in the 99th or higher percentile of the 5-year distribution of O_3monitoring data, OR
  - is one of the four highest O_3 concentrations within 1 year (among those concentrations that have not already been excluded under the Exceptional Events Rule, if any).
- In addition to the analysis required for Tier 1, the air agency should supply additional evidence to support the weight of evidence that emissions from the wildfire affected the monitored O_3 concentration.

- Tier 3: The wildfire does not fall into the specific scenarios (i.e. does not meet the key factors) that qualify for Tier 1 or Tier 2, but the clear causal relationship criterion can still be satisfied by a weight of evidence showing.
  - In addition to the analyses required for Tier 1 and Tier 2, an air agency may further support the clear causal relationship with additional evidence that the fire emissions caused the O_3 exceedance.

Not Reasonably Controllable or Preventable

The Exceptional Events Rule requires that air agencies establish that the event be both not reasonably controllable and not reasonably preventable at the time the event occurred. This requirement applies to both natural events and events caused by human activities; however, it is presumed that wildfires on wildland will satisfy both factors of the "not reasonably controllable or preventable" element unless evidence in the record clearly demonstrates otherwise.[5]

Natural Event

According to the CAA and the Exceptional Events Rule, an exceptional event must be "an event caused by human activity that is unlikely to recur at a particular location *or* a natural event" (emphasis added). The 2016 Exceptional Events Rule includes in the definition of wildfire that "[a] wildfire that predominantly occurs on wildland is a natural event." Once an agency provides evidence that a wildfire on wildland occurred and demonstrates that there is a clear causal relationship between the measurement under consideration and the event, the EPA expects minimal documentation to satisfy the "human activity that is unlikely to recur at a particular location or a natural event" element. The EPA will address wildfires on other lands on a case-by-case basis.

EPA REVIEW OF EXCEPTIONAL EVENTS DEMONSTRATION

On March 16, 2021, CARB submitted an Initial Notification of a potential Exceptional Event for 10 exceedances of the 2015 8-hour O_3 NAAQS that occurred at the Sutter Buttes monitoring site

[5] A wildfire is defined in 40 CFR 50.1(n) as "any fire started by an unplanned ignition caused by lightning; volcanoes; other acts of nature; unauthorized activity; or accidental, human-caused actions, or a prescribed fire that has developed into a wildfire. A wildfire that predominantly occurs on wildland is a natural event." Wildland is defined in 40 CFR 50.1(o) as "an area in which human activity and development are essentially non-existent, except for roads, railroads, power lines, and similar transportation facilities. Structures, if any, are widely scattered."

within Sutter County, California in August 2020.[6] On November 19, 2021, CARB submitted an exceptional event demonstration for two exceedances of the 2015 8-hour O_3 NAAQS that occurred at the Sutter Buttes monitoring site within Sutter County, California (CA) on August 21-22, 2020.[7]

Regulatory Significance

The EPA determined that data exclusion of certain exceedances referenced in the Initial Notification may have a regulatory significance for a determination of attainment by the attainment date for the Sutter Buttes, CA Marginal nonattainment area for the 2015 O_3 NAAQS and worked with CARB to identify the relevant exceedances and monitoring sites affected.[8] Table 1 summarizes the exceedances measured at the Sutter Buttes monitoring site that CARB included in the demonstration.

Table 1: 2015 8-hour O_3 NAAQS Exceedance Summary

Exceedance Date	Monitoring Site Name	AQS ID	2015 8-hour Avg. (ppm)
August 21, 2020	Sutter Buttes	06-101-0004	0.090
August 22, 2020	Sutter Buttes	06-101-0004	0.089

Narrative Conceptual Model

The demonstration submitted by CARB provided a narrative conceptual model in the "Overview/Introduction," "Background," and "Narrative Conceptual Model" sections of the demonstration to describe how emissions from the August Complex, North Complex, Woodward, LNU Lightning Complex, SCU Lightning, and CZU Lightning fires burning in Central and Northern California caused the O_3 exceedances at the Sutter Buttes monitoring site.

The "Overview/Introduction" and "Background" chapters provided information supporting the narrative conceptual model including characteristics of the nonattainment area, such as geography, topography, meteorology, the ambient O_3 monitoring network, typical non-event O_3 formation conditions and patterns, seasonal O_3 variations, and emissions of O_3 precursors.[9] The background described the geography and topography of the broader region in which the Sutter Buttes is located. The Sutter Buttes monitor resides in the Sacramento Valley Air Basin (SVAB), which the demonstration describes as being bounded by the Coastal Mountain Range, the Cascade Mountain Range, and the Sierra Nevada Mountains, which is conducive to pooling of pollution in the region.[10] The demonstration also presented local topographical information showing the unique positioning of the Sutter Buttes ozone monitor at an elevation of 2,115 feet (645 meters) allowing for measurement of high elevation pollutant transport while population exposure monitoring is measured at the nearby, lower elevation (60 feet (18 meters)) Yuba City site.[11] The demonstration shows the largest two sources of NO_x in Sutter County as non-road mobile and on-road mobile sources while the largest two sources of VOC in Sutter County are

[6] See email from Sylvia Vanderspek, CARB, to Gwen Yoshimura, EPA Region 9, dated March 16, 2021.
[7] See letter from Michael Benjamin, CARB, to Matthew Lakin, EPA Region 9, dated November 18, 2021.
[8] See letter from Elizabeth Adams, EPA Region 9, to Sylvia Vanderspek, dated August 27, 2021.
[9] See demonstration, pp. 8-9, 13-15, 16-17.
[10] See demonstration, p. 8.
[11] See demonstration, p. 9.

stationary and areawide sources, with the highest ozone concentrations being measured between April and October during the late afternoon and evening hours.[12]

The narrative conceptual model also described characteristics of the event. This included a summary of wildfires in Northern and Central California and specific descriptions of the August Complex, North Complex, Woodward, LNU Lightning Complex, SCU Lightning, and CZU Lightning wildfires that generated smoke contributing to O_3 exceedances at the Sutter Buttes monitoring site on August 21-22, 2020.[13] The demonstration provided tables for the fires actively burning during the time of the exceedances which include the fire name, cause, start date, containment date, location, and total acreage burned along with maps of the fire perimeters.[14] The narrative conceptual model also included figures displaying meteorological conditions on the dates of the fires and Hybrid Single Particle Lagrangian Integrated Trajectory (HYSPLIT) modeling results. The HYSPLIT trajectory modeling results were presented with satellite imagery, Hazard and Mapping System (HMS) satellite-derived smoke layers, and meteorological analysis to support that wildfire emissions were transported to the Sutter Buttes monitoring site on the exceptional event dates requested for exclusion. Along with these graphics, the narrative conceptual model included narrative descriptions of how dense wildfire smoke from numerous lightning caused wildfires, which combined to form the August, LNU, SCU, CZU and North Complexes, spread across the Sacramento Valley, including Sutter Buttes, and portions of the Sierra Nevada on August 21-22, 2020.[15]

The narrative conceptual model included figures showing event related concentrations and long-term trends. The concentrations of 1-hour O_3 and particulate matter less than or equal to 2.5 microns in aerodynamic diameter ($PM_{2.5}$) from August 1 through September 30, 2020, at the Sutter Buttes monitoring site were presented in Figure III-26. The demonstration states that elevated $PM_{2.5}$ concentrations during the period of the requested exceptional events coincide with elevated ozone concentration which supports the presence of wildfire smoke.[16] The demonstration also included a figure of 8-hour O_3 design values with the trend from 2009-2020 at the Sutter Buttes monitoring site and suggested that the 2020 O_3 design value deviated from the recent slight downward trend that is observed.[17] The narrative conceptual model addressed the regulatory significance of the exceptional event by stating that the exclusion of wildfire events in 2018 and 2020 would affect a determination of attainment for the Sutter Buttes (Butte County), CA Marginal nonattainment area for the 2015 O_3 NAAQS.[18]

The narrative conceptual model also included daily meteorological data such as temperatures and wind speeds along with 1-hr and 8-hr O_3 concentrations from the Sutter Buttes monitoring site.[19] Tables III-20 through III-22 show that wind speeds at the Sutter Buttes monitoring site were lower than average on the two exceptional event days, but still within just over one standard deviation of the mean for all of August, while temperatures were fairly average compared to all August 2020 days. While lower than average wind speeds may have provided for enhanced

[12] See demonstration, p. 16.
[13] See demonstration, pp. 20-22.
[14] See demonstration, pp. 22-60.
[15] See demonstration, pp. 64-67, 138-139, 189-190.
[16] See demonstration, pp. 72-73.
[17] See demonstration, p. 74.
[18] See demonstration, pp. 3-4.
[19] See demonstration, pp. 83-84.

pooling of wildfire emissions, near average temperatures would not be particularly conducive to O_3 formation. The demonstration concluded that the meteorological conditions on the two exceptional event days were not generally more favorable for O_3 formation and unusual weather was not a contributing factor to the observed O_3 exceedances.

Lastly, the narrative conceptual model included descriptions of an air quality advisory issued jointly by the Feather River Air Quality Management District (AQMD) and the Public Health Departments of both Sutter and Yuba counties, as well as several examples of social media coverage of the 2020 wildfires in Northern and Central California as additional evidence of wildfire and smoke impacts in the area.[20]

Overall, the demonstration contained the elements required for inclusion in the conceptual model portion of the exceptional events demonstration.

Table 2: Documentation of the Narrative Conceptual Model

Exceedance Date	**Demonstration Citation**	**Quality of Evidence**	**Criterion Met?**
August 21-22, 2020	"Overview/Introduction": p. 6 "Background": pp. 8-9, 13-15, 16-17 "Narrative Conceptual Model": pp. 20-88 Appendix B: pp. 131-132 Appendix C: pp. 138-139, 189-190 Appendix E: pp. 210-211, 219, 221, 224-227	Sufficient	Yes

Clear Causal Relationship

The demonstration included several analyses to support a clear causal relationship between the wildfire event and the monitored exceedances. These analyses were presented in the "Clear Causal Relationship" section of the demonstration.

Comparison with historical concentrations

The demonstration included a comparison with historical concentrations, as required by 40 CFR §50.14(c)(3)(iv)(C). The demonstration compared O_3 concentrations at the Sutter Buttes monitoring site on the 2020 wildfire exceptional event days to historical non-event O_3 concentrations from 2015-2020. This included a figure of daily maximum 8-hour average concentrations over the six-year period by day of the year, along with lines denoting the NAAQS and the 99th percentile value at the site. As shown in Figure IV-1 and as described in the demonstration, the 8-hour maximum O_3 concentrations of 0.090 and 0.089 ppm for August 21, 2020 and August 22, 2020, respectively, are both at least 0.005 ppm greater than the next highest maximum 8-hour ozone concentration of the past six years (0.084 ppm, measured on August 18, 2016).[21] The figure of daily maximum 8-hour average concentrations from 2015-2020 further shows that the concentrations on August 21-22, 2020 were well above the 99th percentile of 0.080 ppm.

[20] See demonstration, pp. 86-88, 131-132, 210-211, 219, 221, 224-227.
[21] See demonstration, pp. 89-90.

Tier 1: Key Factor

To meet the key factor for a Tier 1 analysis, exceedances should be clearly higher than other non-event related exceedances, or occur during a time of year that typically experiences no exceedances. The exceedances identified in this demonstration fall within the O_3 season but are clearly distinguishable from non-event exceedances (i.e., they are at least 0.005 ppm greater than the non-event exceedances in the past six years).[22] Therefore, the exceedances meet the Tier 1 Key Factor. The EPA's wildfire O_3 guidance document indicates that a Tier 1 analysis may be appropriate for this event. However, the demonstration included the required elements for a Tier 1 clear causal relationship analysis as well as those required for a more stringent Tier 2 clear causal relationship analysis.

Tier 2: Key Factors

The demonstration included an evaluation of the Tier 2 Key Factors. For Tier 2 Key Factor 1, the demonstration provided an analysis of fire emissions (Q) and distance (D) of the wildfires to the monitoring site locations. The Q/D value is generally calculated by dividing wildfire emissions (in tpd) by the distance between the wildfire and the monitoring site (in kilometers [km]). Daily Q/D values were calculated by the EPA using daily wildland fire emissions input files for originally created for the Community Multiscale Air Quality (CMAQ) modeling system. The resulting calculations were shared with CARB to assist in demonstration development. CMAQ input files included daily total emissions of nitrogen oxide, nitrogen dioxide, and reactive organic gases at release points corresponding to wildfire locations. Q/D was calculated for each CMAQ input release point by calculating the distance between release point locations and gridded receptor locations and dividing the associated fire's daily total emissions by this distance. An aggregated daily Q/D was then calculated by summing the individual Q/D values for each release point. An "effective Q/D" value was calculated at monitoring site receptor locations by accounting for periods where multiple days of wildfire smoke buildup impacted the monitoring site for up to three total days; the dates to include in each daily "effective Q/D" were based on meteorology and transport analyses, with the rationale further outlined in the demonstration.[23] The distance-weighted sums for for August 21-22, 2020 are 165 and 137 tpd/km respectively, which are above the Tier 2 Key Factor 1 screening value of 100 tons per day of NO_x and VOC per km. Therefore, the event exceedances meet Tier 2 Key Factor 1.

For Tier 2 Key Factor 2, the demonstration included evidence that the exceedances are at or above the 99th percentile from the past five years of O_3 season data (2015-2019) or among the four highest concentrations measured at the site in 2020. In the demonstration, CARB determined an "adjusted 4th high" corresponding to the 4th highest non-event exceedance monitored in 2020, excluding the exceedances included in the demonstration.[24] CARB stated that dates impacted by exceptional events should not count against the tally of the four highest O_3 concentrations measured in 2020 because these exceedances were caused by contributions from wildfire emissions.[25] This rationale is supported given that the purpose of the test is to show that the exceedances are high compared to non-event data. Since the excluded dates are all included in the demonstration being evaluated in this TSD, each individual date would not count towards the four highest concentrations if concurred on by the EPA. As shown in Table IV-4 of the

[22] See demonstration, pp. 89-90.
[23] See demonstration, pp. 93-95.
[24] See demonstration, pp. 99-100.
[25] See demonstration, p. 99.

demonstration, the monitored O_3 concentrations on all dates requested as exceptional events are above the 99th percentile value for the five-year distribution of O_3 monitoring data (0.080 ppm) and exceed the adjusted 4th high O_3 concentration at the Sutter Buttes monitoring site in 2020.[26] Therefore, the event exceedances meet Tier 2 Key Factor 2.

Based on the analysis of the Key Factors for Tier 2, the EPA's wildfire O_3 guidance document indicates that a Tier 2 analysis is appropriate for this event. As described below, the demonstration included the required elements for a clear causal relationship analysis based on the EPA's wildfire O_3 guidance document. This includes evidence to support that (1) wildfire emissions were transported from the wildfire to the monitor; and (2) wildfire emissions affected the monitor.

Evidence of transport of wildfire emissions from the wildfire to the monitor

The demonstration presented analyses in the "Narrative Conceptual Model" using backward trajectory and forward trajectory modeling.[27] Additional forward and backward trajectory modeling is also presented in Appendix C.3 and C.4, respectively, of the demonstration.[28] HYSPLIT modeling was used to determine back trajectories and forward trajectories that estimate the movement of air parcels and smoke during the event time period.[29] In the "Narrative Conceptual Model" section of the demonstration, HYSPLIT back trajectories showing the likely path of air parcels from two monitoring sites at three elevations (100 meters (m), 500m, and 1000m), for 36 hours prior to the time of peak concentrations, were overlaid on National Oceanic and Atmospheric Administration (NOAA) HMS Fire and Smoke Product imagery. HYSPLIT forward trajectories showing the most likely center path of air parcels for 36 hours beginning at the wildfire locations were overlaid on satellite imagery to provide a visual analysis of whether smoke emitted from the fires may have impacted the Sutter Buttes monitoring site.

The forward trajectories overlaid with visible satellite imagery, as well as the backward trajectories overlaid with NOAA HMS smoke layers, are for August 20, 2020 instead of the event days of August 21-22, 2020 and do not specifically depict the Sutter Buttes monitoring location.[30] However, it is still evident that transport of wildfire smoke into the region of the Sacramento Valley was taking place based on the westerly back trajectories through heavy HMS smoke layers from the Grass Valley monitoring site, which lies east of Sutter Buttes. Furthermore, Appendix C.4 presents backward trajectory modeling from the Sutter Buttes monitor specifically on the event days. These show trajectories from the west and south, which would have intersected areas of dense wildfire smoke resulting from multiple fires, particularly the August Complex and LNU Lightning fires.[31] The forward trajectory modeling included in the "Narrative Conceptual Model" and Appendix C.3 display trajectories from the August Complex and LNU Lightning fires that further supports this, showing trajectories from the fires that approach the Sutter Buttes region.[32] The back trajectory and forward trajectory modeling

[26] See demonstration, pp. 99-100.
[27] See demonstration, pp. 64-67.
[28] See demonstration, pp. 158-188, 189-190.
[29] See demonstration, p. 63.
[30] See demonstration, pp. 66-67.
[31] See demonstration, 189-190.
[32] See demonstration, pp. 66, 159-160, 171-172.

supports that the wildfire emissions were transported to the Sutter Buttes monitoring site on the days requested for exclusion as exceptional events.

Evidence that the wildfire emissions affected the monitor

The demonstration provided evidence that wildfire emissions affected the Sutter Buttes monitor, including Figure III-26 (top) of the "Narrative Conceptual Model" showing hourly O_3 concentrations at the Sutter Buttes monitor and $PM_{2.5}$ concentrations at the nearby Yuba City-Almond St monitor from August 1, 2020 through September 30, 2020.[33] Figure III-26 (bottom) of the demonstration shows a temporal relationship between elevated $PM_{2.5}$ concentrations and elevated O_3 concentrations at the Sutter Buttes monitor during the period of August 17, 2020 through August 26, 2020, including on the O_3 exceedance dates. The demonstration also showed $PM_{2.5}$ concentrations to be generally elevated over the event period in the Sacramento Valley.[34]

Figures IV-4 and IV-5 in subsection C of the "Clear Causal Relationship" section of the demonstration showed the diurnal profiles of O_3 concentrations at the Sutter Buttes monitoring site for August 21 and 22, 2020, compared with seasonal percentiles for 2015-2019.[35] On August 21, 2020, concentrations were above the 95th percentile concentrations from 3:00 PM through 11:00 PM. Concentrations on August 21 peaked around the 6:00 PM and 7:00 PM hours, with 1-hour readings just below 0.110 ppm. The 95th percentile for these hours are approximately 0.035 ppm lower, at around 0.074 ppm. From midnight on August 21 through 8:00 AM on August 22, the majority of 1-hour concentrations were equal to or above the corresponding 95th percentile. Concentrations rose above the 95th percentile again from noon to 7:00 PM, and at 11:00 PM. The 2:00 PM to 3:00 PM concentrations of approximately 0.097 ppm are about 0.030 ppm higher than the corresponding 95th percentile concentrations. The extreme peaks in O_3 concentrations in the evening of August 21, 2020 and in the afternoon of August 22, 2020, the abnormally elevated morning concentrations on August 22 and the spike in concentrations late on August provide further evidence that wildfire emissions impacted the monitor.[36]

Furthermore, the demonstration presented additional evidence of wildfire emissions impacting the Sacramento Valley through data showing enhanced concentrations of atmospheric black carbon in the region, and specifically in the vicinity of the LNU Lightning Complex and August Complex fires.[37] The presence of smoke specifically near the Sutter Buttes within the Sacramento Valley on the requested exceptional event dates was shown in the demonstration through analysis of data from a light detection and ranging (LiDAR) ceilometer positioned at Yuba City station.[38] Through reference to figures which display ceilometer data, the demonstration describes how a high degree of aerosol backscatter was present on August 20-22, 2020 from near the surface up to 1.5 km, which the demonstration notes is indicative of smoke.[39] The demonstration goes on to describe how the apparent mixing of smoke up to 1.5 km means

[33] See demonstration, p. 73.
[34] See demonstration, p. 109.
[35] See demonstration, p. 103.
[36] See demonstration, p. 102.
[37] See demonstration, pp. 110-111.
[38] See demonstration, pp. 112-114.
[39] See demonstration, p. 112.

that, despite the Sutter Buttes monitor being at a higher elevation than Yuba City, the depth of the smoke layer would have yielded impacts to both the Sutter Buttes and Yuba City monitors.[40]

Excerpts from National Weather Service (NWS) area forecast discussions demonstrating wildfire smoke impacts were included in section 2 of Appendix C of the demonstration for each day from August 19 through August 22, 2020.[41] Several media reports were also included in Appendix E of the demonstration, including photographic evidence showing that smoke plumes reached the ground in the Sacramento Valley and at the Sutter Buttes in particular.[42]

Conclusion

The analyses included in the demonstration, specifically, the comparison of event-related O_3 concentrations with non-event O_3 concentrations, analysis of diurnal O_3 concentration profiles, Q/D analysis, HYSPLIT forward and backward trajectories, wildfire smoke emissions estimates, meteorological conditions, air quality district alerts and advisories, NOAA HMS smoke products, evidence of elevated $PM_{2.5}$ concentrations, data showing elevated black carbon in the region, ceilometer data showing smoke throughout the atmospheric mixed layer, and news and media reports, sufficiently demonstrate a clear causal relationship between the emissions generated by the August Complex, North Complex, Woodward, LNU Lightning Complex, SCU Lightning, and CZU Lightning fires and the exceedances measured at the Sutter Buttes monitoring site.

Table 3: Documentation of the Clear Causal Relationship criterion

Exceedance Date	Demonstration Citation	Quality of Evidence	Criterion Met?
August 21-22, 2020	"Narrative Conceptual Model": pp. 63-67, 73 "Clear Causal Relationship": pp. 89-90, 93-95, 99-100, 102-103, 109-114 Appendix C: 141-151, 158-190 Appendix E: pp. 210-211, 227	Sufficient	Yes

Not Reasonably Controllable or Preventable

The Exceptional Events Rule presumes that wildfire events on wildland are not reasonably controllable or preventable [40 CFR §50.14(b)(4)]. The demonstration provided evidence that the wildfire event meets definition of wildfire [40 CFR §50.1(n)]. Specifically, the demonstration included maps and descriptions of the wildfires, along with figures showing wildfire boundaries overlaid upon land ownership and wildland-urban interface layers to demonstrate that the fires occurred on wildland or in the urban/wildland interface.[43] The demonstration described that CARB is not aware of any evidence clearly demonstrating that prevention or control efforts beyond those actually made would have been reasonable.[44] Therefore, the documentation provided sufficiently demonstrates that the event was not reasonably controllable and not reasonably preventable.

[40] See demonstration, pp. 112-113.
[41] See demonstration, pp. 141-151.
[42] See demonstration, pp. 210-211, 227.
[43] See demonstration, pp. 21-62.
[44] See demonstration, p. 117.

Table 4: Documentation of the Not Reasonably Controllable or Preventable criterion

Exceedance Date	Demonstration Citation	Quality of Evidence	Criterion Met?
August 21-22, 2020	"Narrative Conceptual Model": pp. 21-62 "Not reasonably Controllable and/or Not Reasonably Preventable": p. 117	Sufficient	Yes

Natural Event

The definition of "wildfire" at 40 CFR §50.1(n) states, "A wildfire that predominantly occurs on wildland is a natural event." As previously described, the demonstration included documentation that the event meets the definition of a wildfire and occurred predominantly on wildland and has therefore shown that the event was a natural event.

Table 5: Documentation of the Natural Event criterion

Exceedance Date	Demonstration Citation	Quality of Evidence	Criterion Met?
August 21-22, 2020	"Narrative Conceptual Model": pp. 60-62 "Natural Event/Human Activity Unlikely to Recur": p.117	Sufficient	Yes

Schedule and Procedural Requirements

In addition to technical demonstration requirements, 40 CFR §50.14(c) and 40 CFR §51.930 specify schedule and procedural requirements an air agency must follow to request data exclusion. Table 6 outlines the EPA's evaluation of these requirements.

Table 6: Schedules and Procedural Criteria

	Reference	Demonstration Citation	Criterion Met?
Did the agency provide prompt public notification of the event?	40 CFR §50.14 (c)(1)(i)	"Narrative Conceptual Model": pp. 86-88 "Public Notification": pp. 117-118 Appendix B: pp. 131-132 Appendix E: pp. 219, 221, 224-226	Yes
Did the agency submit an Initial Notification of Potential Exceptional Event and flag the affected data in the EPA's Air Quality System (AQS)?	40 CFR §50.14 (c)(2)(i)	Appendix A: pp. 123-125	Yes

	Reference	Demonstration Citation	Criterion Met?
Did the initial notification and demonstration submittals meet the deadlines for data influenced by exceptional events for use in initial area designations, if applicable? Or the deadlines established by the EPA during the Initial Notification of Potential Exceptional Events process, if applicable?	40 CFR §50.14 Table 2 40 CFR §50.14 (c)(2)(i)(B)	See letter from Elizabeth Adams, EPA R9, to Sylvia Vanderspek, CARB, dated March 21, 2021 See letter from Elizabeth Adams, EPA R9, to Sylvia Vanderspek, CARB, dated August 27, 2021	Yes
Was the public comment process followed and documented? • Did the agency document that the comment period was open for a minimum of 30 days? • Did the agency submit to the EPA any public comments received? Did the state address comments disputing or contradicting factual evidence provided in the demonstration?	40 CFR §50.14 (c)(3)(v)	"Public Notification": pp.117-118 See letter from Michael Benjamin, CARB, to Matthew Lakin, EPA R9, dated January 7, 2022	Yes
Has the agency met requirements regarding submission of a mitigation plan, if applicable?	40 CFR §51.930 (b)	NA	NA

Conclusion

The EPA has reviewed the documentation provided by CARB to support claims that smoke from wildfires in Central and Northern California, namely the August Complex, North Complex, Woodward, LNU Lightning Complex, SCU Lightning, and CZU Lightning fires, caused exceedances of the 2015 8-hour O_3 NAAQS at the Sutter Buttes monitoring site on August 21-22, 2020. The EPA has determined that the flagged exceedances at this monitoring site on these days satisfies the exceptional event criteria: the event was a natural event, which affected air quality in such a way that there exists a clear causal relationship between the event and the monitored exceedances, and was not reasonably controllable or preventable. The EPA has also determined that CARB has satisfied the schedule and procedural requirements for data exclusion.

ENCLOSURE: TECHNICAL SUPPORT DOCUMENT FOR EPA CONCURRENCE ON O_3 EXCEEDANCES MEASURED IN TUOLUMNE COUNTY, CALIFORNIA ON JULY 28-31, AUGUST 2, AUGUST 4-6, AND AUGUST 8-10 OF 2018 AS AN EXCEPTIONAL EVENT

On September 17, 2021, the California Air Resources Board (CARB) submitted an exceptional event demonstration for exceedances of the 2015 8-hour ozone (O_3) National Ambient Air Quality Standards (NAAQS) of 0.070 parts per million (ppm) that occurred at the Sonora-Barretta Street monitoring site between July 28, 2018 and August 10, 2018.[1] The demonstration submitted by CARB stated that the exceedances measured on July 28-31, August 2, August 4-6, and August 8-10 of 2018 were caused by multiple wildfires burning in Northern and Central California, namely the Ranch, River, Carr, Donnell, and Ferguson fires.[2] Under the Exceptional Events Rule, air agencies can request the exclusion of event-influenced data, and the EPA can agree to exclude these data, from the data set used for certain regulatory decisions. The remainder of this document summarizes the Exceptional Events Rule requirements, the event and the EPA's review process.

EXCEPTIONAL EVENTS RULE REQUIREMENTS

The EPA promulgated the Exceptional Events Rule in 2007, pursuant to the 2005 amendment of Clean Air Act (CAA) Section 319. In 2016, the EPA finalized revisions to the Exceptional Events Rule. The 2007 Exceptional Events Rule and 2016 Exceptional Events Rule revisions added sections 40 CFR §50.1(j)-(r); §50.14; and §51.930 to title 40 of the Code of Federal Regulations (CFR). These sections contain definitions, criteria for EPA approval, procedural requirements, and requirements for air agency demonstrations. The EPA reviews the information and analyses in the air agency's demonstration package using a weight of evidence approach and decides to concur or not concur. The demonstration must satisfy all of the Exceptional Events Rule criteria for the EPA to concur with excluding the air quality data from regulatory decisions.

Under 40 CFR §50.14(c)(3)(iv), the air agency demonstration to justify exclusion of data must include:

A. "A narrative conceptual model that describes the event(s) causing the exceedance or violation and a discussion of how emissions from the event(s) led to the exceedance or violation at the affected monitor(s);"

B. "A demonstration that the event affected air quality in such a way that there exists a clear causal relationship between the specific event and the monitored exceedance or violation;"

C. "Analyses comparing the claimed event-influenced concentration(s) to concentrations at the same monitoring site at other times" to support requirement (B) above;

[1] "Exceptional Events Demonstration for Ozone Exceedances; Northern California; July-August 2018 Wildfire Events", (September 17, 2021) ("demonstration"). The demonstration addresses multiple events and exceedances measured in Northern California in July – August 2018. The EPA's evaluation of the information presented in the demonstration is reflected in seven separate TSDs, grouped by nonattainment area affected.
[2] See demonstration, p. 68.

D. "A demonstration that the event was both not reasonably controllable and not reasonably preventable;" and

E. "A demonstration that the event was a human activity that is unlikely to recur at a particular location or was a natural event."[3]

In addition, the air agency must meet several procedural requirements, including:

1. submission of an Initial Notification of Potential Exceptional Event and flagging of the affected data in the EPA's Air Quality System (AQS) as described in 40 CFR §50.14(c)(2)(i),

2. completion and documentation of the public comment process described in 40 CFR §50.14(c)(3)(v), and

3. implementation of any relevant mitigation requirements as described in 40 CFR §51.930.

For data influenced by exceptional events to be to be excluded from use in initial area designations, air agencies must also meet the initial notification and demonstration submission deadlines specified in Table 2 to 40 CFR §50.14. We include below a summary of the Exceptional Events Rule criteria, including those identified in 40 CFR §50.14(c)(3)(iv).

Regulatory Significance

The 2016 Exceptional Events Rule includes regulatory language that applies the provisions of CAA section 319 to a specific set of regulatory actions. As identified in 40 CFR §50.14(a)(1)(i), these regulatory actions include initial area designations and redesignations; area classifications; attainment determinations (including clean data determinations); attainment date extensions; findings of State Implementation Plan (SIP) inadequacy leading to a SIP call; and other actions on a case-by-case basis as determined by the Administrator. Air agencies and the EPA should discuss the regulatory significance of an exceptional events demonstration during the Initial Notification of Potential Exceptional Event prior to the air agency submitting a demonstration for the EPA's review.

Narrative Conceptual Model

The 2016 Exceptional Events Rule directs air agencies to submit, as part of the demonstration, a narrative conceptual model of the event that describes and summarizes the event in question and provides context for analyzing the required statutory and regulatory technical criteria. Air agencies may support the narrative conceptual model with summary tables or maps. For wildfire O_3 events, the EPA recommends that the narrative conceptual model also discuss the interaction of emissions, meteorology, and chemistry of event and non-event O_3 formation in the area, and,

[3] A natural event is further described in 40 CFR 50.1(k) as "an event and its resulting emissions, which may recur at the same location, in which human activity plays little or no direct causal role. For purposes of the definition of a natural event, anthropogenic sources that are reasonably controlled shall be considered to not play a direct role in causing emissions."

under 40 CFR §50.14(a)(1)(i), must describe the regulatory significance of the proposed data exclusion.

Clear Causal Relationship and Supporting Analyses

The EPA considers a variety of evidence when evaluating whether there is a clear causal relationship between a specific event and the monitored exceedance or violation. For wildfire O_3 events, air agencies should compare the O_3 data requested for exclusion with seasonal and annual historical concentrations at the air quality monitor to establish a clear causal relationship between the event and monitored data. In addition to providing this information on the historical context for the event-influenced data, air agencies should further support the clear causal relationship criterion by demonstrating that the wildfire's emissions were transported to the monitor, that the emissions from the wildfire influenced the monitored concentrations, and, in some cases, air agencies may need to provide evidence of the contribution of the wildfire's emissions to the monitored O_3 exceedance or violation.

For wildfire O_3 events, the EPA has published a guidance document that provides three different tiers of analyses that apply to the "clear causal relationship" criterion within an air agency's exceptional events demonstration.[4] This tiered approach recognizes that some wildfire events may be more clear and/or extreme and, therefore, require relatively less evidence to satisfy the rule requirements. If a wildfire/O_3 event satisfies the key factors for either Tier 1 or Tier 2 clear causal analyses, then those analyses are the only analyses required to support the clear causal relationship criterion within an air agency's demonstration for that particular event. Other wildfire/O_3 events will be considered based on Tier 3 analyses.

- Tier 1: Wildfires that clearly influence monitored O_3 exceedances or violations when they occur in an area that typically experiences lower O_3 concentrations.
    - *Key Factor*: seasonality and/or distinctive level of the monitored O_3 concentration. The event-related exceedance occurs during a time of year that typically has no exceedances, or is clearly distinguishable (*e.g.*, 5-10 parts per billion (ppb) higher) from non-event exceedances.
    - In these situations, O_3 impacts should be accompanied by clear evidence that the wildfire's emissions were transported to the location of the monitor.

- Tier 2: The wildfire event's O_3 influences are higher than non-event related concentrations, and fire emissions compared to the fire's distance from the affected monitor indicate a clear causal relationship.
    - *Key Factor 1*: fire emissions and distance of fire(s) to affected monitoring site location(s). Calculated fire emissions of nitrogen oxides (NO_x) and reactive-volatile organic compounds (VOC) in tons per day (Q) divided by the distance from the fire to the monitoring site (D) should be equal to or greater than 100 tons per day/kilometers ($Q/D \geq 100$ tpd/km). The guidance document provides additional information on the calculation of Q/D.

[4] "Guidance on the Preparation of Exceptional Events Demonstrations for Wildfire Events that May Influence Ozone Concentrations" (September 2016) ("wildfire O_3 guidance document").

- *Key Factor 2*: comparison of the event-related O_3 concentration with non-event related high O_3 concentrations. The exceedance due to the exceptional event:
  - is in the 99th or higher percentile of the 5-year distribution of O_3 monitoring data, OR
  - is one of the four highest O_3 concentrations within 1 year (among those concentrations that have not already been excluded under the Exceptional Events Rule, if any).
- In addition to the analysis required for Tier 1, the air agency should supply additional evidence to support the weight of evidence that emissions from the wildfire affected the monitored O_3 concentration.

- Tier 3: The wildfire does not fall into the specific scenarios (i.e., does not meet the key factors) that qualify for Tier 1 or Tier 2, but the clear causal relationship criterion can still be satisfied by a weight of evidence showing.
  - In addition to the analyses required for Tier 1 and Tier 2, an air agency may further support the clear causal relationship with additional evidence that the fire emissions caused the O_3 exceedance.

Not Reasonably Controllable or Preventable

The Exceptional Events Rule requires that air agencies establish that the event be both not reasonably controllable and not reasonably preventable at the time the event occurred. This requirement applies to both natural events and events caused by human activities; however, it is presumed that wildfires on wildland will satisfy both factors of the "not reasonably controllable or preventable" element unless evidence in the record clearly demonstrates otherwise.[5]

Natural Event

According to the CAA and the Exceptional Events Rule, an exceptional event must be "an event caused by human activity that is unlikely to recur at a particular location *or* a natural event" (emphasis added). The 2016 Exceptional Events Rule includes in the definition of wildfire that "[a] wildfire that predominantly occurs on wildland is a natural event." Once an agency provides evidence that a wildfire on wildland occurred and demonstrates that there is a clear causal relationship between the measurement under consideration and the event, the EPA expects minimal documentation to satisfy the "human activity that is unlikely to recur at a particular location or a natural event" element. The EPA will address wildfires on other lands on a case-by-case basis.

EPA REVIEW OF EXCEPTIONAL EVENTS DEMONSTRATION

On March 16, 2021 CARB submitted an Initial Notification of a potential Exceptional Event for 20 exceedances of the 2015 8-hour O_3 NAAQS that occurred at the Sonora-Barretta Street

[5] A wildfire is defined in 40 CFR 50.1(n) as "any fire started by an unplanned ignition caused by lightning; volcanoes; other acts of nature; unauthorized activity; or accidental, human-caused actions, or a prescribed fire that has developed into a wildfire. A wildfire that predominantly occurs on wildland is a natural event." Wildland is defined in 40 CFR 50.1(o) as "an area in which human activity and development are essentially non-existent, except for roads, railroads, power lines, and similar transportation facilities. Structures, if any, are widely scattered."

monitoring site within Tuolumne County between July 18, 2018 and August 25, 2018.[6] On September 17, 2021, CARB submitted an exceptional event demonstration for 11 exceedances of the 2015 8-hour O_3 NAAQS that occurred at the Sonora-Barretta Street monitoring site within Tuolumne County between July 28 and August 10, 2018.[7]

Regulatory Significance

The EPA determined that data exclusion of certain exceedances referenced in the Initial Notification may have a regulatory significance for a determination of attainment by the attainment date for the Tuolumne County, CA Marginal nonattainment area under the 2015 8-hour O_3 NAAQS and worked with CARB to identify the relevant exceedances and monitoring sites affected.[8] Table 1 summarizes the exceedances measured at the Sonora-Barretta Street monitoring site that CARB included in the demonstration.

Table 1: 2015 8-hour O_3 NAAQS Exceedance Summary

Exceedance Date	Monitoring Site Name	AQS ID	2015 8-hour Avg. (ppm)
July 28, 2018	Sonora-Barretta Street	06-109-0005	0.079
July 29, 2018	Sonora-Barretta Street	06-109-0005	0.079
July 30, 2018	Sonora-Barretta Street	06-109-0005	0.076
July 31, 2018	Sonora-Barretta Street	06-109-0005	0.078
August 2, 2018	Sonora-Barretta Street	06-109-0005	0.078
August 4, 2018	Sonora-Barretta Street	06-109-0005	0.074
August 5, 2018	Sonora-Barretta Street	06-109-0005	0.084
August 6, 2018	Sonora-Barretta Street	06-109-0005	0.080
August 8, 2018	Sonora-Barretta Street	06-109-0005	0.087
August 9, 0218	Sonora-Barretta Street	06-109-0005	0.074
August 10, 2018	Sonora-Barretta Street	06-109-0005	0.079

Narrative Conceptual Model

The demonstration submitted by CARB provided a narrative conceptual model in the "Overview/Introduction," "Background," and "Narrative Conceptual Model" chapters of the demonstration to describe how emissions from the wildfires in Northern and Central California caused the O_3 exceedances at the Sonora-Barretta Street monitoring site. The narrative conceptual model addressed the regulatory significance of the exceptional event by stating that the exclusion of wildfire events in 2018 and 2020 would affect a determination of attainment for the Tuolumne County, CA Marginal nonattainment area for the 2015 O_3 NAAQS.[9]

The "Overview/Introduction" and "Background" sections of the demonstration provided information supporting the narrative conceptual model including characteristics of the nonattainment area and surrounding areas, such as geography, topography, meteorology, the

[6] See email from Sylvia Vanderspek, CARB, to Gwen Yoshimura, EPA Region 9, dated March 16, 2021.
[7] See letter from Michael Benjamin, CARB, to Elizabeth Adams, EPA Region 9, dated September 17, 2021.
[8] See letter from Elizabeth Adams, EPA Region 9, to Sylvia Vanderspek, CARB, dated August 27, 2021.
[9] See demonstration pp. 2, 68.

ambient O_3 monitoring network, descriptions of typical O_3 formation emissions, and seasonal O_3 variations.[10]

The "Narrative Conceptual Model" section described event-related characteristics. This included a summary of the event, stating that wildfires burned from mid-July to August 2018 and that the wildfire emissions impacted the nonattainment area on the exceedance days between July 28, 2018 and August 10, 2018.[11] The demonstration specifically identified the Carr Fire, Mendocino Complex (i.e., Ranch and River fires), Ferguson, and Donnell wildfires as the fires that produced the majority of the emissions that affected the Sonora-Barretta Street monitoring site. The demonstration provided tables for actively burning wildfires in Northern and Central California during the time of the exceedances, including fire start and end dates, daily and total acres burned, along with maps of the fire perimeters and air quality monitors.[12]

The narrative conceptual model also included a description of the general meteorological conditions that lead to transport of wildfire emissions from the fires in Northern and Central California to the nonattainment area and provided daily surface weather, temperature, and pressure maps from the National Weather Service (NWS) for July 26–August 10 of 2018.[13] Overall, CARB's Hybrid Single Particle Lagrangian Integrated Trajectory (HYSPLIT) trajectory model results presented with Moderate Resolution Imaging Spectroradiometer (MODIS) satellite layers and Hazard and Mapping System (HMS) smoke plume analysis supports that wildfires emissions in California dispersed throughout the Northern and Central California due to a high-pressure ridge and winds moving south and east into the Mountain County Air Basin.[14] Following the initial smoke dispersion, hot, above average temperatures and stagnant conditions allowed for the Donnell fire to spread and smoke and O_3 precursors to accumulate in the mountainous region (including Tuolumne County) further contributing to high O_3 concentrations at the Sonora-Barretta Street monitoring site.[15]

The narrative conceptual model presented 1-hour O_3 and particulate matter less than or equal to 2.5 microns in aerodynamic diameter ($PM_{2.5}$) concentrations for Tuolumne County from July 15 through August 15, 2018, as well as 8-hour O_3 design values and annual 4th high trends from 2009-2020 in graph form.[16] Since the Sonora monitoring site only monitors for O_3, $PM_{2.5}$ concentrations from the San Andreas-Gold Strike Rd monitoring site, 22 miles northwest of the Sonora site, were used. The demonstration suggested that the timing of increased $PM_{2.5}$ concentrations show strong connections with O_3 increases and prolonged elevated concentrations during the time of the wildfire events.[17]

[10] See demonstration, pp. 14-15, 17-19, 23, 26, 68-69.
[11] See demonstration, pp. 40-42.
[12] See demonstration, pp. 28-40.
[13] See demonstration, Appendix III, pp. 215-223.
[14] See demonstration, pp. 42-61.
[15] See demonstration, pp. 55-56.
[16] See demonstration, pp. 68-69.
[17] See demonstration, p. 68.

Additionally, the demonstration provided public notices from Tuolumne County Public Health Department, and news and social media reports to support that the area experienced wildfire smoke during the time of the exceedances.[18]

Based on the information above, CARB's demonstration meets the narrative conceptual model criterion of the EER.

Table 2: Documentation of the Narrative Conceptual Model

Exceedance Date	Demonstration Citation	Quality of Evidence	Criterion Met?
July 28-31, 2018 August 2, 2018 August 4-6, 2018 August 8-10, 2018	"Overview/Introduction": pp. 1-9 "Background": pp. 14-15, 17-19, 23, 26 "Narrative Conceptual Model – July 26-August 10, 2018": pp. 27-61, 68-69, 77, 79-82 Appendix II-D: pp. 181-195 Appendix III: pp. 215-223	Sufficient	Yes

Clear Causal Relationship

The demonstration included several analyses to support a clear causal relationship between the wildfire event and the monitored exceedances. These analyses are presented in the "Clear Causal Relationship" chapter of the demonstration.

Comparison with historical concentrations

The demonstration included a comparison with historical concentrations, as required by 40 CFR §50.14(c)(3)(iv)(C). The demonstration compared O_3 concentrations at the Sonora-Barretta Street monitoring site on the 2018 exceptional event days to historical non-event O3 concentrations from 2013-2018. This included a graph of daily maximum 8-hour average concentrations over the six-year period by day of year, along with the level of NAAQS and the 99th percentile value at the site. The demonstration noted that the exceptional events occurred during the time of year when O_3 concentrations tend to be higher for all monitoring sites and that the exceptional event exceedances at the Sonora-Barretta Street monitoring site are not clearly distinguishable from non-event exceedances as defined by guidance.[19]

Tier 1: Key Factor

To meet the key factor for a Tier 1 analysis, exceedances should be clearly higher than other non-event related exceedances or occur during a time of year that typically experiences no exceedances. The exceedances identified in this demonstration occurred during regular O_3 season, during times when other exceedances similar in magnitude were measured. The O_3 concentrations at Sonora-Barretta Street monitoring site on event days identified in this demonstration do not exceed non-event exceedance concentrations by at least 5 ppb.[20] Therefore, the exceedances do not meet the Tier 1 Key Factor and additional evidence beyond a Tier 1 analysis is needed to support the clear causal relationship.

[18] See demonstration, Appendix II- D, pp. 181-195.
[19] See demonstration, pp. 83-84.
[20] See demonstration, p. 88.

Tier 2: Key Factors

The demonstration included an evaluation of the Tier 2 Key Factors. For Tier 2 Key Factor 1, the demonstration provided an analysis of fire emissions (Q) and distance (D) of the wildfires to the monitoring site locations. The Q/D value is generally calculated by dividing wildfire emissions (in tons per day) by the distance between the wildfire and the monitoring site (in kilometers [km]). Daily Q/D values were calculated by the EPA using daily wildland fire emissions input files originally created for the Community Multiscale Air Quality (CMAQ) modeling system. The resulting calculations were shared with CARB to assist in demonstration development. CMAQ input files included daily total emissions of nitrogen oxide (NO), nitrogen dioxide (NO_2), and reactive organic gases (ROG) at release points corresponding to wildfire locations. Q/D was calculated for each CMAQ input release point by calculating the distance between release point locations and gridded receptor locations and dividing the associated fire's daily total emissions by this distance. An aggregated daily Q/D was then calculated by summing the individual Q/D values for each release point. An "effective Q/D" value was then calculated at monitoring site receptor locations by accounting for periods where multiple days of wildfire smoke buildup impacted the monitoring site for up to three total days; the dates to include in each daily "effective Q/D" was based on meteorology and transport analyses, with the rationale further outlined in the demonstration.[21] The effective distance-weighted sum for all dates requested as exceptional events at the Sonora-Barretta Street monitoring site are greater than the Tier 2 Key Factor 1 screening value of 100 tons per day of NO_x and VOC per km.[22] Therefore, the event exceedances meet Tier 2 Key Factor 1.

For Tier 2 Key Factor 2, the demonstration included evidence that the exceedances are at or above the 99th percentile from the past five years of O_3 season data (2013-2017) or among the adjusted four highest concentrations measured at the site in 2018. In the demonstration, CARB determined an "adjusted 4th high" corresponding to the 4th highest non-event exceedance monitored in 2018, excluding the exceedances included in the demonstration.[23] CARB stated that dates impacted by exceptional events should not count against the tally of the four highest O_3 concentrations measured in 2018 because these exceedances were caused by contributions from wildfire emissions.[24] This rationale is supported given that the purpose of the test is to show that the exceedances are high compared to non-event data. Since the excluded dates are all included in the demonstration being evaluated in this TSD, each individual date would not count towards the four highest concentrations if concurred on by the EPA. Table 4-9 of the demonstration included the top 20 max daily O_3 concentrations measured at Sonora in 2018. The table shows that six of the exceptional event dates (7/28, 7/29, 8/5, 8/6, 8/8, and 8/10) are at or above 5-year 99th percentile and the remaining five dates (7/30, 7/31, 8/2, 8/4, and 8/9) are at or above the 2018 adjusted 4th high O_3 concentration of 0.074 ppb.[25] Therefore, the event exceedances meet Tier 2 Key Factor 2.

Based on the analysis of the Key Factors for Tier 2, the EPA's wildfire O_3 guidance document indicates that a Tier 2 analysis is appropriate for this event. As described below, the demonstration included the required elements for a Tier 2 clear causal relationship analysis based

[21] See demonstration, pp. 90-93.
[22] See demonstration pp. 96-97.
[23] See demonstration, p. 102.
[24] See demonstration, pp. 98-99.
[25] See demonstration, pp. 101-102.

on the EPA's wildfire O_3 guidance document. This includes evidence to support that (1) wildfire emissions were transported from the wildfire to the monitor; and (2) wildfire emissions affected the monitor.

Evidence of transport of wildfire emissions from the wildfire to the monitor

The demonstration presented analyses in the Narrative Conceptual Model chapter and Appendix IV using backward trajectory and forward trajectory modeling. HYSPLIT modeling was used to determine back trajectories and forward trajectories that estimate the movement of air parcels and smoke during the event time period.[26] HYSPLIT back trajectories showing the likely path of air parcels for 36 hours prior to the time of peak concentrations on July 30, 2018 and August 10, 2018 at three elevations (100 meters (m), 500 m, and 1,000 m) were overlaid on National Oceanic and Atmospheric Administration (NOAA) HMS Fire and Smoke Product imagery.[27] HYSPLIT forward trajectories showing the most likely center path of air parcels for 36 hours beginning at the wildfire location were overlaid on satellite imagery to provide a visual analysis of whether smoke emitted from the fires may have impacted ambient O_3 concentrations at the Sonora-Barretta Street monitoring site.[28] The back trajectories from the Sonora-Barretta Street monitoring site pass through areas of heavy smoke and occasionally near the fire locations, while the forward trajectories from the Mendocino Complex, Donell, and Ferguson wildfires approach the monitoring site. The back trajectory and forward trajectory analyses support that wildfire emissions were transported to the Sonora-Barretta Street monitoring site on the days requested for exclusion as exceptional events.

Evidence that the wildfire emissions affected the monitor

The demonstration provided 1-hour O_3 and $PM_{2.5}$ concentrations (measured at San Andreas-Gold Strike Rd monitoring station) for Tuolumne County between July 15 and August 15, 2018, in the "Narrative Conceptual Model" chapter. The graph showed elevated $PM_{2.5}$ and O_3 concentrations starting July 28th, with concentrations remaining high through August 10th. The demonstration stated the timing of relative $PM_{2.5}$ elevated concentrations show strong connections with O_3 increases and prolonged elevated concentrations.[29] The $PM_{2.5}$ and O_3 concentration trends correlate with the days of actively burning fires and transport of smoke to the monitor, as well as sustained high concentrations due to stagnant air in early August. The demonstration also provided daily $PM_{2.5}$ values at selected sites in the Mountain Counties Air Basin (i.e. Colfox, Grass Valley, Chester, Quincy, and San Andreas) from July 1, 2018 through August 30, 2018 to further support that elevated $PM_{2.5}$ concentrations were a result of smoke and emissions from wildfires burning in Northern and Central California which impacted nearby monitors at the surface during the event period.[30]

The demonstration also included figures comparing the daily diurnal pattern of O_3 concentrations on each exceptional event day to hourly diurnal O_3 percentiles from 2013-2017. Overall, these figures show that O_3 peak concentrations, typically between the 13th and 19th hour, were above

[26] See demonstration, pp. 46-61, Appendix IV, pp. 241-307, 317-320.
[27] See demonstration, pp. 48, 61.
[28] See demonstration, pp. 44, 47, 50, 54, 57, 60.
[29] See demonstration, pp. 68-69.
[30] See demonstration, pp. 136-137.

the 95th percentile and substantially deviated from the normal diurnal patterns on August 2nd, 4th, and 5th of 2018. [31]

The demonstration included data on the meteorological conditions during the event. Table 3-15 and 3-16 show that average and maximum daily temperatures and wind speeds for exceptional event days were within one standard deviation of the average and maximum daily temperatures and windspeeds for non-event days during the July and August months.[32] Table 3-20 includes the 1-hour and 8-hour O_3 concentrations along with wind speed and temperature from July 26 through August 10, 2018. Despite having similar temperatures in the mid to high 90°F range, and only moderately varied wind speeds (3-7 miles per hour (mph)), the non-event days during this time period (7/26, 7/27, 8/1, 8/3, and 8/7) measured significantly lower O_3 concentrations. The demonstration concluded that weather patterns observed at the Sonora-Barretta Street monitoring site on exceptional event days were not more favorable for O_3 formation than non-event-days from July 26 through August 10, 2018, and that O_3 directly related to wildfire smoke influenced the exceedances rather than unusual weather.[33]

The demonstration also included black carbon and biomass burning indicator analyses. Figure 4-70 of the demonstration showed the concentrations of three biomass burning indicators (levoglucosan, mannosan, and galactosan) measured at Portola, Chico, and Sacramento from July 1 to August 31, 2018. Although these sites do not consistently monitor during the summer months, they were active during the summer of 2018.[34] The two samples collected during the time addressed in this demonstration, on July 31st and August 6th of 2018, show concentrations across all three sites that are among the highest concentrations measured during the period in the figures. Elevated concentrations of these biomass burning indicators during the time of the requested exceptional event support the presence of wildfire smoke in the area. The demonstration also included a map of black carbon smoke plumes associated with the Carr, Mendocino, and Ferguson Fires, and noted that wildfires are a major source of black carbon emissions in California.[35] The map shows moderate concentrations of atmospheric black carbon over Tuolumne County, near to the Ferguson Fire, which supports evidence of wildfire smoke reaching the Sonora-Barretta Street monitoring site during the time of the exceedances.

Lastly, the demonstration included additional news and media reports to support that smoke was observed at ground level and affected air quality in areas at and near the Sonora-Baretta Street monitoring site. These reports include Tuolumne County air quality and health advisories, NWS Air Quality Alerts, NWS Area Forecast Discussions, and NOAA Smoke Texts.[36] These analyses and associated information support the weight of evidence that smoke was observed at ground level and affected the Sonora-Barretta Street monitoring site during the time of the exceedances.

[31] See demonstration, pp. 119-124.
[32] See demonstration, p. 74.
[33] See demonstration, p. 77.
[34] See demonstration, pp. 138-139.
[35] See demonstration, pp. 140-141.
[36] See demonstration Appendices II-D, III-B, V, and VI, pp. 181-195, 223-238, 341, 352-353.

Conclusion

The analyses included in the demonstration, specifically comparison to historical concentrations, Tier 2 Key Factors including Q/D analyses, HYSPLIT modeling and satellite observations of smoke, correlation between $PM_{2.5}$ and O_3 during the event dates, evidence of impacts to hourly O_3 data, presence of biomass burning tracers, and related NWS and NOAA statements on smoke, sufficiently demonstrate a clear causal relationship between the emissions generated by the wildfires in Northern California and the California/Oregon border and the exceedances measured at Sonora-Barretta Street monitoring site.

Table 3: Documentation of the Clear Causal Relationship criterion

Exceedance Date	Demonstration Citation	Quality of Evidence	Criterion Met?
July 28-31, 2018 August 2, 2018 August 4-6, 2018 August 8-10, 2018	"Narrative Conceptual Model – July 26-August 10, 2018": pp. 41-61, 68-69, 74, 77 "Clear Causal Relationship": pp. 83-84, 88, 90-93, 96-99, 101-102, 119-124, 136-141 Appendix II-D: pp. 181-195 Appendix III-B: pp. 223-238 Appendix IV: pp. 241-307, 317-320 Appendix V: pp. 327-338 Appendix VI: pp. 341, 352-353	Sufficient	Yes

Not Reasonably Controllable or Preventable

The Exceptional Events Rule presumes that wildfire events on wildland are not reasonably controllable or preventable [40 CFR §50.14(b)(4)]. The demonstration provided evidence that the wildfire event meets definition of wildfire [40 CFR §50.1(n)]. Specifically, the demonstration included maps and descriptions of the wildfires, along with figures showing wildfire boundaries overlaid upon land ownership and wildland-urban interface layers to demonstrate that the fires occurred on wildland or in the urban/wildland interface.[37] The demonstration described that CARB is not aware of any evidence clearly demonstrating that prevention or control efforts beyond those actually made would have been reasonable.[38] Therefore, the documentation provided sufficiently demonstrates that the event was not reasonably controllable and not reasonably preventable.

Table 4: Documentation of the Not Reasonably Controllable or Preventable criterion

Exceedance Date	Demonstration Citation	Quality of Evidence	Criterion Met?
July 28-31, 2018 August 2, 2018 August 4-6, 2018 August 8-10, 2018	"Narrative Conceptual Model – July 26-August 10, 2018": pp. 27-40 "Not Reasonably Controllable and/or Not Reasonably Preventable": p. 145	Sufficient	Yes

Natural Event

The definition of "wildfire" at 40 CFR §50.1(n) states, "A wildfire that predominantly occurs on wildland is a natural event." As previously described, the demonstration included documentation

[37] See demonstration, pp. 27-40.
[38] See demonstration, p. 145.

that the event meets the definition of a wildfire and occurred predominantly on wildland and has therefore shown that the event was a natural event.

Table 5: Documentation of the Natural Event criterion

Exceedance Date	Demonstration Citation	Quality of Evidence	Criterion Met?
July 28-31, 2018 August 2, 2018 August 4-6, 2018 August 8-10, 2018	"Narrative Conceptual Model – July 26-August 10, 2018": pp. 27-40 "Natural Event/Human Activity Unlikely to Recur": p. 145	Sufficient	Yes

Schedule and Procedural Requirements

In addition to technical demonstration requirements, 40 CFR §50.14(c) and 40 CFR §51.930 specify schedule and procedural requirements an air agency must follow to request data exclusion. Table 6 outlines the EPA's evaluation of these requirements.

Table 6: Schedules and Procedural Criteria

	Reference	Demonstration Citation	Criterion Met?
Did the agency provide prompt public notification of the event?	40 CFR § 50.14 (c)(1)(i)	"Narrative Conceptual Model – July 26-August 10, 2018": pp. 79-80 Appendix II-D: pp. 181-195	Yes
Did the agency submit an Initial Notification of Potential Exceptional Event and flag the affected data in the EPA's Air Quality System (AQS)?	40 CFR § 50.14 (c)(2)(i)	Appendix I-D: pp. 158-161	Yes
Did the initial notification and demonstration submittals meet the deadlines for data influenced by exceptional events for use in initial area designations, if applicable? Or the deadlines established by the EPA during the Initial Notification of Potential Exceptional Events process, if applicable?	40 CFR § 50.14 Table 2 40 CFR § 50.14 (c)(2)(i)(B)	Letter from Gwen Yoshimura, EPA R9, to Sylvia Vanderspek, CARB, dated April 21, 2021	Yes
Was the public comment process followed and documented? • Did the agency document that the comment period was open for a minimum of 30 days? • Did the agency submit to the EPA any public comments received? • Did the state address comments disputing or contradicting factual evidence provided in the demonstration?	40 CFR § 50.14 (c)(3)(v)	Letter from Michael Benjamin, CARB, to Elizabeth Adams, EPA R9, dated October 28, 2021	Yes
Has the agency met requirements regarding submission of a mitigation plan, if applicable?	40 CFR § 51.930 (b)	N/A	N/A

Conclusion

The EPA has reviewed the documentation provided by CARB to support claims that smoke from wildfires in Northern and Central California, namely the Ranch, River, Carr, Donnell, and Ferguson fires caused exceedances of the 2015 8-hour O_3 NAAQS at Sonora-Barretta Street monitoring site on July 28-31, August 2, August 4-6, and August 8-10 of 2018. The EPA has determined that the flagged exceedances at this monitoring site on these days satisfy the exceptional event criteria: the event was a natural event, which affected air quality in such a way that there exists a clear causal relationship between the event and the monitored exceedances and was not reasonably controllable or preventable. The EPA has also determined that CARB has satisfied the schedule and procedural requirements for data exclusion.

ENCLOSURE: TECHNICAL SUPPORT DOCUMENT FOR EPA CONCURRENCE ON O_3 EXCEEDANCES MEASURED IN TUOLUMNE COUNTY, CALIFORNIA ON AUGUST 20-22, 2020 AS AN EXCEPTIONAL EVENT

On November 19, 2021, the California Air Resources Board (CARB) submitted an exceptional event demonstration for exceedances of the 2015 8-hour ozone (O_3) National Ambient Air Quality Standards (NAAQS) of 0.070 parts per million (ppm) that occurred at the Sonora monitoring site on August 20-22, 2020.[1] The demonstration submitted by CARB stated that the exceedances measured on August 20-22, 2020 were caused by numerous wildfire complexes burning in California, including the August, LNU, SCU, CZU, and North complex fires, as well as the Salt and Moc fires.[2] Under the Exceptional Events Rule, air agencies can request the exclusion of event-influenced data, and the EPA can agree to exclude these data, from the data set used for certain regulatory decisions. The remainder of this document summarizes the Exceptional Events Rule requirements, the event and the EPA's review process.

EXCEPTIONAL EVENTS RULE REQUIREMENTS

The EPA promulgated the Exceptional Events Rule in 2007, pursuant to the 2005 amendment of Clean Air Act (CAA) Section 319. In 2016, the EPA finalized revisions to the Exceptional Events Rule. The 2007 Exceptional Events Rule and 2016 Exceptional Events Rule revisions added sections 40 CFR §50.1(j)-(r); §50.14; and §51.930 to title 40 of the Code of Federal Regulations (CFR). These sections contain definitions, criteria for EPA approval, procedural requirements, and requirements for air agency demonstrations. The EPA reviews the information and analyses in the air agency's demonstration package using a weight of evidence approach and decides to concur or not concur. The demonstration must satisfy all of the Exceptional Events Rule criteria for the EPA to concur with excluding the air quality data from regulatory decisions.

Under 40 CFR §50.14(c)(3)(iv), the air agency demonstration to justify exclusion of data must include:

A. "A narrative conceptual model that describes the event(s) causing the exceedance or violation and a discussion of how emissions from the event(s) led to the exceedance or violation at the affected monitor(s);"

B. "A demonstration that the event affected air quality in such a way that there exists a clear causal relationship between the specific event and the monitored exceedance or violation;"

C. "Analyses comparing the claimed event-influenced concentration(s) to concentrations at the same monitoring site at other times" to support requirement (B) above;

[1] "Exceptional Events Demonstration for Ozone Exceedances Northern California 2020 Wildfire Events," (November 18, 2021) ("demonstration")." The demonstration also includes exceptional events analyses for other California nonattainment areas for the 2008 and/or 2015 NAAQS. The EPA's evaluation of the information presented in the demonstration is reflected in four separate technical support documents.

[2] See demonstration, p. 64.

D. "A demonstration that the event was both not reasonably controllable and not reasonably preventable;" and

E. "A demonstration that the event was a human activity that is unlikely to recur at a particular location or was a natural event."[3]

In addition, the air agency must meet several procedural requirements, including:

1. submission of an Initial Notification of Potential Exceptional Event and flagging of the affected data in the EPA's Air Quality System (AQS) as described in 40 CFR §50.14(c)(2)(i),

2. completion and documentation of the public comment process described in 40 CFR §50.14(c)(3)(v), and

3. implementation of any relevant mitigation requirements as described in 40 CFR §51.930.

For data influenced by exceptional events to be excluded from use in initial area designations, air agencies must also meet the initial notification and demonstration submission deadlines specified in Table 2 to 40 CFR §50.14. We include below a summary of the Exceptional Events Rule criteria, including those identified in 40 CFR §50.14(c)(3)(iv).

Regulatory Significance

The 2016 Exceptional Events Rule includes regulatory language that applies the provisions of CAA section 319 to a specific set of regulatory actions. As identified in 40 CFR §50.14(a)(1)(i), these regulatory actions include initial area designations and redesignations; area classifications; attainment determinations (including clean data determinations); attainment date extensions; findings of State Implementation Plan (SIP) inadequacy leading to a SIP call; and other actions on a case-by-case basis as determined by the Administrator. Air agencies and the EPA should discuss the regulatory significance of an exceptional events demonstration during the Initial Notification of Potential Exceptional Event prior to the air agency submitting a demonstration for the EPA's review.

Narrative Conceptual Model

The 2016 Exceptional Events Rule directs air agencies to submit, as part of the demonstration, a narrative conceptual model of the event that describes and summarizes the event in question and provides context for analyzing the required statutory and regulatory technical criteria. Air agencies may support the narrative conceptual model with summary tables or maps. For wildfire O_3 events, the EPA recommends that the narrative conceptual model also discuss the interaction of emissions, meteorology, and chemistry of event and non-event O_3 formation in the area, and,

[3] A natural event is further described in 40 CFR 50.1(k) as "an event and its resulting emissions, which may recur at the same location, in which human activity plays little or no direct causal role. For purposes of the definition of a natural event, anthropogenic sources that are reasonably controlled shall be considered to not play a direct role in causing emissions."

under 40 CFR §50.14(a)(1)(i), must describe the regulatory significance of the proposed data exclusion.

Clear Causal Relationship and Supporting Analyses

The EPA considers a variety of evidence when evaluating whether there is a clear causal relationship between a specific event and the monitored exceedance or violation. For wildfire O_3 events, air agencies should compare the O_3 data requested for exclusion with seasonal and annual historical concentrations at the air quality monitor to establish a clear causal relationship between the event and monitored data. In addition to providing this information on the historical context for the event-influenced data, air agencies should further support the clear causal relationship criterion by demonstrating that the wildfire's emissions were transported to the monitor, that the emissions from the wildfire influenced the monitored concentrations, and, in some cases, air agencies may need to provide evidence of the contribution of the wildfire's emissions to the monitored O_3 exceedance or violation.

For wildfire O_3 events, the EPA has published a guidance document that provides three different tiers of analyses that apply to the "clear causal relationship" criterion within an air agency's exceptional events demonstration.[4] This tiered approach recognizes that some wildfire events may be more clear and/or extreme and, therefore, require relatively less evidence to satisfy the rule requirements. If a wildfire/O_3 event satisfies the key factors for either Tier 1 or Tier 2 clear causal analyses, then those analyses are the only analyses required to support the clear causal relationship criterion within an air agency's demonstration for that particular event. Other wildfire/O_3 events will be considered based on Tier 3 analyses.

- Tier 1: Wildfires that clearly influence monitored O_3 exceedances or violations when they occur in an area that typically experiences lower O_3 concentrations.
    - *Key Factor*: seasonality and/or distinctive level of the monitored O_3 concentration. The event-related exceedance occurs during a time of year that typically has no exceedances, or is clearly distinguishable (*e.g.*, 5-10 parts per billion (ppb) higher) from non-event exceedances.
    - In these situations, O_3 impacts should be accompanied by clear evidence that the wildfire's emissions were transported to the location of the monitor.

- Tier 2: The wildfire event's O_3 influences are higher than non-event related concentrations, and fire emissions compared to the fire's distance from the affected monitor indicate a clear causal relationship.
    - *Key Factor 1*: fire emissions and distance of fire(s) to affected monitoring site location(s). Calculated fire emissions of nitrogen oxides (NO_x) and reactive-volatile organic compound (VOC) in tons per day (Q) divided by the distance from the fire to the monitoring site (D) should be equal to or greater than 100 tons per day/kilometers ($Q/D \geq 100$ tpd/km). The guidance document provides additional information on the calculation of Q/D.

[4] "Guidance on the Preparation of Exceptional Events Demonstrations for Wildfire Events that May Influence Ozone Concentrations" (September 2016) ("wildfire O_3 guidance document").

- *Key Factor 2*: comparison of the event-related O_3 concentration with non-event related high O_3 concentrations. The exceedance due to the exceptional event:
  - is in the 99th or higher percentile of the 5-year distribution of O_3 monitoring data, OR
  - is one of the four highest O_3 concentrations within 1 year (among those concentrations that have not already been excluded under the Exceptional Events Rule, if any).
- In addition to the analysis required for Tier 1, the air agency should supply additional evidence to support the weight of evidence that emissions from the wildfire affected the monitored O_3 concentration.

- Tier 3: The wildfire does not fall into the specific scenarios (i.e. does not meet the key factors) that qualify for Tier 1 or Tier 2, but the clear causal relationship criterion can still be satisfied by a weight of evidence showing.
  - In addition to the analyses required for Tier 1 and Tier 2, an air agency may further support the clear causal relationship with additional evidence that the fire emissions caused the O_3 exceedance.

Not Reasonably Controllable or Preventable

The Exceptional Events Rule requires that air agencies establish that the event be both not reasonably controllable and not reasonably preventable at the time the event occurred. This requirement applies to both natural events and events caused by human activities; however, it is presumed that wildfires on wildland will satisfy both factors of the "not reasonably controllable or preventable" element unless evidence in the record clearly demonstrates otherwise.[5]

Natural Event

According to the CAA and the Exceptional Events Rule, an exceptional event must be "an event caused by human activity that is unlikely to recur at a particular location *or* a natural event" (emphasis added). The 2016 Exceptional Events Rule includes in the definition of wildfire that "[a] wildfire that predominantly occurs on wildland is a natural event." Once an agency provides evidence that a wildfire on wildland occurred and demonstrates that there is a clear causal relationship between the measurement under consideration and the event, the EPA expects minimal documentation to satisfy the "human activity that is unlikely to recur at a particular location or a natural event" element. The EPA will address wildfires on other lands on a case-by-case basis.

EPA REVIEW OF EXCEPTIONAL EVENTS DEMONSTRATION

On March 16, 2021, CARB submitted an Initial Notification of a potential Exceptional Event for five exceedances of the 2015 8-hour O_3 NAAQS that occurred at the Sonora monitoring site

[5] A wildfire is defined in 40 CFR 50.1(n) as "any fire started by an unplanned ignition caused by lightning; volcanoes; other acts of nature; unauthorized activity; or accidental, human-caused actions, or a prescribed fire that has developed into a wildfire. A wildfire that predominantly occurs on wildland is a natural event." Wildland is defined in 40 CFR 50.1(o) as "an area in which human activity and development are essentially non-existent, except for roads, railroads, power lines, and similar transportation facilities. Structures, if any, are widely scattered."

within Tuolumne County, California on August 20-24, 2020.[6] On November 19, 2021, CARB submitted an exceptional event demonstration for three exceedances of the 2015 8-hour O_3 NAAQS that occurred at the Sonora monitoring site within Tuolumne County, California (CA) on August 20-22, 2020.[7]

Regulatory Significance

The EPA determined that data exclusion of certain exceedances referenced in the Initial Notification may have a regulatory significance for a determination of attainment by the attainment date for the Tuolumne County, CA Marginal nonattainment area for the 2015 NAAQS and worked with CARB to identify the relevant exceedances and monitoring site affected.[8] Table 1 summarizes the exceedances measured at the Sonora monitoring site that CARB included in the demonstration.

Table 1: 2015 8-hour O_3 NAAQS Exceedance Summary

Exceedance Date	Monitoring Site Name	AQS ID	2015 8-hour Avg. (ppm)
August 20, 2020	Sonora	06-109-0005	0.081
August 21, 2020	Sonora	06-109-0005	0.083
August 22, 2020	Sonora	06-109-0005	0.081

Narrative Conceptual Model

The demonstration submitted by CARB provided a narrative conceptual model in the "Overview/Introduction," "Background," and "Narrative Conceptual Model" sections of the demonstration to describe how emissions from numerous wildfire complexes burning in California, including the August, LNU, SCU, CZU, and North complex fires, as well as the Salt and Moc individual fires caused the O_3 exceedances at the Sonora monitoring site.

The "Overview/Introduction" and "Background" chapters provided information supporting the narrative conceptual model including characteristics of the nonattainment area, such as geography, topography, meteorology, the ambient O_3 monitoring network, typical non-event O_3 formation conditions and patterns, seasonal O_3 variations, and emissions of O_3 precursors.[9]

The narrative conceptual model described characteristics of the event. This included a summary of the occurances of wildfires in Northern and Central California and specific descriptions of individual wildfires, such as the Moc and Salt fires, that generated smoke contributing to O_3 exceedances at the Sonora monitoring site from August 20-22, 2020.[10] The demonstration provided tables for the actively burning fires during the time of the exceedances which include the fire name, cause, start date, containment date, location, and total acreage burned along with maps of the fire perimeters.[11] The narrative conceptual model also included figures displaying meteorological conditions on the dates of the fires and Hybrid Single Particle Lagrangian

[6] See email from Sylvia Vanderspek, CARB, to Gwen Yoshimura, EPA Region 9, dated March 16, 2021.
[7] See letter from Michael Benjamin, CARB, to Matthew Lakin, EPA Region 9, dated November 18, 2021.
[8] See letter from Elizabeth Adams, EPA Region 9, to Sylvia Vanderspek, CARB, dated April 21, 2021.
[9] See demonstration pp. 10-11, 12-15, 17-18, 20.
[10] See demonstration pp. 20-22.
[11] See demonstration, pp. 22-60.

Integrated Trajectory (HYSPLIT) modeling results. The HYSPLIT trajectory modeling results were presented with satellite imagery, National Oceanic and Atmospheric Administration (NOAA) Hazard and Mapping System (HMS) satellite-derived smoke layers, and meteorological analysis to support that wildfire emissions were transported to the Sonora monitoring site on the exceptional event dates requested for exclusion. Along with these graphics, the narrative conceptual model included narrative descriptions of how dense wildfire smoke from numerous lightning strikes caused wildfires, which combined to form the August, LNU, SCU, CZU, and North Complexes, as well as the Salt and Moc fires near the Sonora monitoring site spread across the Sacramento Valley and into the Sierra Nevada foothills on August 20-22, 2020.[12]

The narrative conceptual model included charts showing event related concentrations and long-term trends. The concentrations of 1-hour O_3 measured at the Sonora monitoring site and particulate matter less than or equal to 2.5 microns in aerodynamic diameter ($PM_{2.5}$) measured at the nearby San Andreas-Gold Strike Rd monitoring site from August 1-31, 2021 were presented in Figure III-29. The demonstration states that elevated $PM_{2.5}$ concentrations during the period of the requested exceptional events coincident with elevated O_3 concentrations support the presence of wildfire smoke at the Sonora monitoring site. The demonstration also included charts of 8-hour O_3 design values and annual 4th high 8-hour O_3 averages from 2009-2020 for the Sonora monitoring site. These charts included trendlines and the 2018, 2019, and 2020 values with and without the requested exceptional event days to suggest that wildfire impacts may have influenced 2018-2020 design values. The narrative conceptual model addressed the regulatory significance of the exceptional event by stating that the exclusion of wildfire events in 2018 and 2020 would affect determination of attainment for the Tuolumne County, CA Marginal nonattainment area for the 2015 O_3 NAAQS.[13]

The narrative conceptual model also included daily meteorological data (temperatures and wind speeds) along with 1-hour and 8-hour O_3 concentrations from the Sonora monitoring site. Tables III-20 and III-21 show that the average temperatures and wind speeds at Sonora for the exceptional event days were within one standard deviation of the non-event days in August 2020. Table III-23 presented the maximum daily 1-hour and 8-hour O_3, temperature, and wind speed on the exceptional event and surrounding days (August 17-26, 2020). The demonstration concluded that the maximum ozone concentrations measured during this time period varied significantly while wind speeds and temperatures remained relatively stable, therefore weather patterns observed at the Sonora monitoring site on the exceptional event days were not generally more favorable for O_3 formation than on non-event days during the event period.[14] Based on information presented in Table III-23, conditions on August 20-22, 2020 (Thursday-Saturday) and August 26, 2020 (Wednesday) appear similar, with maximum wind speeds from 2.9-4.8 miles per hour, and temperatures from 89.2 to 93.6 degrees Fahrenheit. The maximum 1-hour concentration measured on August 26 is at least 0.026 ppm lower than the maximum measured on the exceedance days; the maximum 8-hour concentration measured on August 26 is at least 0.022 ppm lower. The demonstration concluded that O_3 directly related to wildfire smoke influenced the exceedances as opposed to unusual weather.[15] The narrative conceptual model included descriptions of air quality advisories issued by Tuolumne County Public Health

[12] See demonstration, pp. 64-67.
[13] See demonstration, pp. 75-77.
[14] See demonstration, p. 84.
[15] See demonstration, pp. 82-84.

Department and the Tuolumne County Air Pollution Control District (APCD), as well as examples of social media coverage of the 2020 wildfires in Northern and Central California.[16]

Overall, the demonstration contained the elements required for inclusion in the conceptual model portion of the exceptional events demonstration.

Table 2: Documentation of the Narrative Conceptual Model

Exceedance Date	Demonstration Citation	Quality of Evidence	Criterion Met?
August 20-22, 2020	"Overview/Introduction": p. 1-4 "Background": pp. 10-15, 17-18 "Narrative Conceptual Model": pp. 20-67, 75-78, 83-86 "Clear Causal Relationship": p. 88 Appendix B: p. 133 Appendix C: pp. 138-139, 141-151 Appendix E: pp. 198-228	Sufficient	Yes

Clear Causal Relationship

The demonstration included several analyses to support a clear causal relationship between the wildfire event and the monitored exceedances. These analyses were presented in the "Clear Causal Relationship" section of the demonstration.

Comparison with historical concentrations

The demonstration included a comparison with historical concentrations, as required by 40 CFR §50.14(c)(3)(iv)(C). The demonstration compared O_3 concentrations at the Sonora monitoring site on the 2020 wildfire exceptional event days to historical non-event O_3 concentrations from 2015-2020. This included a graph of daily maximum 8-hour average concentrations over the six-year period by day of the year, along with the level of the NAAQS and the 99th percentile value at the site. The August 20 and 21, 2020 measurements are only slightly above the 99th percentile and are not clearly distinguishable from non-event exceedances that occurred during this time of year.[17]

Tier 1: Key Factor

To meet the key factor for a Tier 1 analysis, exceedances should be clearly higher than other non-event related exceedances, or occur during a time of year that typically experiences no exceedances. The exceedances identified in this demonstration occurred during times when O_3 concentrations tend to be higher at the Sonora monitoring site and do not exceed non-event concentrations by at least 5 ppb.[18] Therefore, the exceedances do not meet the Tier 1 Key Factor and additional evidence beyond a Tier 1 analysis is needed to support the clear causal relationship.

Tier 2: Key Factors

The demonstration included an evaluation of the Tier 2 Key Factors. For Tier 2 Key Factor 1, the demonstration provided an analysis of fire emissions (Q) and distance (D) of the wildfires to the

[16] See demonstration, pp. 86, 133, and Appendix D and E.
[17] See demonstration, p. 91.
[18] See demonstration, pp. 89-90.

monitoring site locations. The Q/D value is generally calculated by dividing wildfire emissions (in tpd) by the distance between the wildfire and the monitoring site (in kilometers [km]). Daily Q/D values were calculated by the EPA using daily wildland fire emissions input files originally created for the Community Multiscale Air Quality (CMAQ) modeling system. The resulting calculations were shared with CARB to assist in demonstration development. CMAQ input files included daily total emissions of nitrogen oxide, nitrogen dioxide, and reactive organic gases at release points corresponding to wildfire locations. Q/D was calculated for each CMAQ input release point by calculating the distance between release point locations and gridded receptor locations and dividing the associated fire's daily total emissions by this distance. An aggregated daily Q/D was then calculated by summing the individual Q/D values for each release point. An "effective Q/D" value was then calculated at monitoring site receptor locations by accounting for periods where multiple days of wildfire smoke buildup impacted the monitoring site for up to three total days; the dates to include in each daily "effective Q/D" were based on meteorology and transport analyses, with the rationale further outlined in the demonstration.[19] The distance-weighted sums for August 20-22, 2020 are 203, 177, and 125 tpd/km respectively, which are above the Tier 2 Key Factor 1 screening value of 100 tons per day of NO_x and VOC per km.[20] Therefore, the event exceedances meet Tier 2 Key Factor 1.

For Tier 2 Key Factor 2, the demonstration included evidence that the exceedances are at or above the 99th percentile from the past five years of O_3 season data (2015-2019) or among the four highest concentrations measured at the site in 2020. In the demonstration, CARB determined an "adjusted 4th high" corresponding to the 4th highest non-event exceedance monitored in 2020, excluding the exceedances for which CARB submitted an exceptional events demonstration.[21] CARB stated that dates impacted by exceptional events should not count against the tally of the four highest O_3 concentrations measured in 2020 because these exceedances were caused by contributions from wildfire emissions.[22] This rationale is supported given that the purpose of the test is to show that the exceedances are high compared to non-event data. Since the excluded dates are all included in the demonstration being evaluated in this TSD, each individual date would not count towards the four highest concentrations if concurred on by the EPA. As shown in Table IV-5 of the demonstration, the monitored O_3 concentrations on all dates requested as exceptional events exceed the adjusted 4th high O_3 concentration of 0.069 ppm at the Sonora monitoring site in 2020.[23] Therefore, the event exceedances meet Tier 2 Key Factor 2.

Based on the analysis of the Key Factors for Tier 2, the EPA's wildfire O_3 guidance document indicates that a Tier 2 analysis is appropriate for this event. As described below, the demonstration included the required elements for a clear causal relationship analysis based on the EPA's wildfire O_3 guidance document. This includes evidence to support that (1) wildfire emissions were transported from the wildfire to the monitor; and (2) wildfire emissions affected the monitor.

[19] See demonstration, pp. 93-97.
[20] See demonstration, p. 96.
[21] See demonstration, p. 99.
[22] See demonstration, p. 100.
[23] See demonstration, p. 100.

Evidence of transport of wildfire emissions from the wildfire to the monitor

The demonstration presented analyses in the "Narrative Conceptual Model" and Appendix C using backward trajectory and forward trajectory modeling. HYSPLIT modeling was used to determine back trajectories and forward trajectories that estimate the movement of air parcels and smoke during the event period.[24] In Figure III-22, HYSPLIT back trajectories originating at the monitor location at three elevations (1000 meters (m), 500m, and 100m), showing the likely path of air parcels for 36 hours prior to the time of peak concentrations on August 20, 2020, were overlaid on NOAA HMS Fire and Smoke Product imagery.[25] In Figure III-21, HYSPLIT forward trajectories beginning at wildfire locations on August 20, 2020, showing the most likely center path of air parcels for 36 hours, were overlaid on satellite imagery to provide a visual analysis of whether smoke emitted from the fires may have impacted the Sonora monitoring site.[26] Additional HYSPLIT forward and backward trajectories were providing in Appendix C of the demonstration.[27] Back trajectories from the Sonora monitoring site pass through areas of heavy smoke and near the LNU and SCU Lightning Complex and Woodward fire locations.[28] The forward trajectories from the LNU Lightning complex and Salt and Moc fires approach the Sonora site.[29] The backward and forward trajectory analyses support that the wildfire emissions were transported to the Sonora monitoring site on the days requested for exclusion as exceptional events.

Evidence that the wildfire emissions affected the monitor

The demonstration provided additional evidence that wildfire emissions affected the monitor through the correlation of O_3 and $PM_{2.5}$, O_3 diurnal patterns, media reports, and additional measurements such as ceilometer and black carbon.

The demonstration included charts of daily 1-hour O_3 concentrations at the Sonora monitoring site and 1-hour $PM_{2.5}$ at the San Andreas-Gold Strike Rd monitoring site (22 miles northwest of the Sonora monitoring site) during the time of the event. The concentrations of O_3 were elevated from August 20 through August 24, 2020, at the Sonora monitoring site. The concentrations of $PM_{2.5}$ at San Andreas-Gold Strike Rd, the nearest $PM_{2.5}$ monitoring site, were elevated for the same period, indicating the presence of wildfire emissions impacting both sites. In Figure III-29 (bottom), 1-hour O_3 and $PM_{2.5}$ concentrations are shown from August 17-26, 2020. These data show that on August 20, 2020, the $PM_{2.5}$ concentrations rose rapidly to over 200 $\mu g/m^3$ while the O_3 concentrations rose to over 0.080 ppm around the same time of day. Both species monitored high concentrations through August 24th, with 1-hour O_3 concentrations measuring greater than 0.80 ppm each day and 1-hour $PM_{2.5}$ concentrations measuring greater than 100 $\mu g/m^3$ each day. The correlation between $PM_{2.5}$ and O_3 increases and ongoing elevated concentrations during the timing of the event supports the presence of wildfire smoke on the town of Sonora.[30]

The O_3 diurnal patterns are presented in Figure IV-6 for August 20, 2020, Figure IV-7 for August 21, 2020, and Figure IV-8 for August 22, 2020. In Figure IV-6, the O_3 values rapidly increase from the level of the 50th percentile for seasonal 1-hour O_3 measurements during 2015-

[24] See demonstration, pp. 64-67, Appendix C, pp.158-188, 190-192.
[25] See demonstration, p. 67.
[26] See demonstration, p. 66.
[27] See demonstration, Appendix C, pp. 158-188, 190-192.
[28] See demonstration, p. 67, Appendix C, pp. 190-192.
[29] See demonstration, p. 66, Appendix C, pp. 171-174, 181-182, 187-188.
[30] See demonstration, pp. 75-78.

2019 at approximately 12:00PM PST, to nearly reaching the 95th percentile at 1:00PM. 1-hour concentrations stay above or close to the 95th percentile values throughout the rest of the day on August 20, 2020, with the maximum 1-hour value occuring around 3:00PM. In Figure IV-7, the O_3 measurements at Sonora for August 21, 2020 remain high through 3:00AM, then decrease before climbing dramatically again around 8:00AM. These measurements again exceed the 95th percentile of seasonal 1-hour O_3 measurements over 2015-2019 beginning at 11:00AM PST and remain above the 95th percentile through the end of the day for all but one hour. In Figure IV-8, the O_3 measurements at Sonora for August 22, 2020 remain elevated in the early morning hours, then decrease below the 95th percentile at 6:00AM before starting to increase again at 7:00AM. The August 22, 2020 concentrations exceed the associated 95th percentile values from 1:00AM to 5:00AM and from 10:00AM PST to 3:00PM PST. These trends are unusual because typically the highest daily O_3 values occur late in the afternoon (4:00 to 6:00PM). The initial increase on August 20, 2020 is much larger and earlier in the day than would be expected during a normal daily diurnal pattern. Concentrations do not decrease as much overnight as would be expected, and on August 21 and 22, concentrations again climb more quickly and earlier in the day than the typical daily diurnal pattern.[31]

The demonstration included air quality advisories issued by Tuolumne County and NWS Area Forecast Discussions of smoke. These included air quality alerts in Northern and Central California reporting unhealthy air quality and visible smoke at ground level. The demonstration also provided professional and social media posts of the 2020 wildfires.[32]

Additional evidence that emissions caused the exceedances by reaching the ground and the monitor includes the ceilometer data from Yuba City station in Figure IV-20, Figure IV-21, and Figure IV-22. These show high density aerosols close to the ground and aloft, with well-mixed wildfire smoke below 1 km from August 20-21, 2020.[33]

Black carbon is emitted from fires with moist fuels that burn at lower temperatures where incomplete combustion occurs, and large plumes were observed from CZU Lightning Complex, SCU Lightning Complex, LNU Lightning Complex, August Complex, North Complex, Dolan Fire, and other wildfires using the GEOS-5 forward processing model. These emissions often correlate with other VOC emissions and are presented in the demonstration for August 20, 2020; Figure IV-18 shows wildfire black carbon in the region near the Sonora monitoring site.[34] This supports the presence of wildfire smoke impacting the monitor. Additional biomass burning indicators such as levoglucosan, mannosan, and galactosan were not measured during 2020 because speciated monitors typically don't monitor during summer months and were shut down due to the COVID-19 pandemic restrictions.[35]

Conclusion

The analyses included in the demonstration, specifically, comparison to historical concentrations and typical diurnal O_3 and $PM_{2.5}$ concentration profiles, Q/D analyses, BC analysis, ceilometer data, HYSPLIT forward and backward trajectory analyses, satellite imagery and descriptions,

[31] See demonstration, pp. 104-105.
[32] See demonstration, pp. 133, 141-151, 215, 222.
[33] See demonstration, pp. 112-114.
[34] See demonstration, pp. 110-111.
[35] See demonstration, p. 110.

meteorological conditions, air quality district alerts and advisories, social and news media posts, and NOAA HMS smoke products, sufficiently demonstrate a clear causal relationship between the emissions generated by numerous wildfire complexes burning in California, including the August, LNU, SCU, CZU, and North complex fires, as well as the Salt and Moc individual fires and the exceedances measured at the Sonora monitoring site.

Table 3: Documentation of the Clear Causal Relationship criterion

Exceedance Date	Demonstration Citation	Quality of Evidence	Criterion Met?
August 20-22, 2020	"Narrative Conceptual Model": pp. 62-67, 75-78, 82-86 "Clear Causal Relationship": pp. 88-94, 95-97, 99-100, 104-105, 109-114 Appendix B: p. 133 Appendix C: pp. 138-139, 141-151, 158-188, 190-192. Appendix E: p. 198	Sufficient	Yes

Not Reasonably Controllable or Preventable

The Exceptional Events Rule presumes that wildfire events on wildland are not reasonably controllable or preventable [40 CFR §50.14(b)(4)]. The demonstration provided evidence that the wildfire event meets definition of wildfire [40 CFR §50.1(n)]. Specifically, the demonstration included maps and descriptions of the wildfires, along with figures showing wildfire boundaries overlaid upon land ownership and wildland-urban interface layers to demonstrate that the fires occurred on wildland or in the urban/wildland interface.[36] The demonstration described that CARB is not aware of any evidence clearly demonstrating that prevention or control efforts beyond those actually made would have been reasonable.[37] Therefore, the documentation provided sufficiently demonstrates that the event was not reasonably controllable and not reasonably preventable.

Table 4: Documentation of the Not Reasonably Controllable or Preventable criterion

Exceedance Date	Demonstration Citation	Quality of Evidence	Criterion Met?
August 20-22, 2020	"Narrative Conceptual Model": pp. 20-62 "Not reasonably Controllable and/or Not Reasonably Preventable": p. 117	Sufficient	Yes

Natural Event

The definition of "wildfire" at 40 CFR §50.1(n) states, "A wildfire that predominantly occurs on wildland is a natural event." As previously described, the demonstration included documentation that the event meets the definition of a wildfire and occurred predominantly on wildland and has therefore shown that the event was a natural event.

[36] See demonstration, pp. 20-62.
[37] See demonstration, p. 117.

Table 5: Documentation of the Natural Event criterion

Exceedance Date	Demonstration Citation	Quality of Evidence	Criterion Met?
August 20-22, 2020	"Narrative Conceptual Model"*:* pp. 20-62 "Natural Event/Human Activity Unlikely to Recur": p.117	Sufficient	Yes

Schedule and Procedural Requirements

In addition to technical demonstration requirements, 40 CFR §50.14(c) and 40 CFR §51.930 specify schedule and procedural requirements an air agency must follow to request data exclusion. Table 6 outlines the EPA's evaluation of these requirements.

Table 6: Schedules and Procedural Criteria

	Reference	Demonstration Citation	Criterion Met?
Did the agency provide prompt public notification of the event?	40 CFR §50.14 (c)(1)(i)	"Public Notification": pp. 117-118; Appendix B: p. 133; Appendix E pp. 205-209, 212-216, 220	Yes
Did the agency submit an Initial Notification of Potential Exceptional Event and flag the affected data in the EPA's Air Quality System (AQS)?	40 CFR §50.14 (c)(2)(i)	Appendix A. Initial Notification: pp. 126-128	Yes
Did the initial notification and demonstration submittals meet the deadlines for data influenced by exceptional events for use in initial area designations, if applicable? Or the deadlines established by the EPA during the Initial Notification of Potential Exceptional Events process, if applicable?	40 CFR §50.14 Table 2 40 CFR §50.14 (c)(2)(i)(B)	See letter from Elizabeth Adams, EPA, to Sylvia Vanderspek, CARB, dated March 21, 2021 See letter from Elizabeth Adams, EPA, to Sylvia Vanderspek, CARB, dated August 27, 2021	Yes

	Reference	Demonstration Citation	Criterion Met?
Was the public comment process followed and documented? • Did the agency document that the comment period was open for a minimum of 30 days? • Did the agency submit to the EPA any public comments received? • Did the state address comments disputing or contradicting factual evidence provided in the demonstration?	40 CFR §50.14 (c)(3)(v)	"Public Notification": p.117-118, See letter from Michael Benjamin, CARB, to Matthew Lakin, EPA R9, dated January 7, 2022	Yes
Has the agency met requirements regarding submission of a mitigation plan, if applicable?	40 CFR §51.930 (b)	NA	NA

Conclusion

The EPA has reviewed the documentation provided by CARB to support claims that smoke from numerous wildfires in Northern California, including the August, LNU, SCU, CZU, and North complex fires, as well as the Salt and Moc fires, caused exceedances of the 2015 8-hour O_3 NAAQS at the Sonora monitoring site on August 20-22, 2020. The EPA has determined that the flagged exceedances at this monitoring site on these days satisfy the exceptional event criteria: the event was a natural event, which affected air quality in such a way that there exists a clear causal relationship between the event and the monitored exceedances, and was not reasonably controllable or preventable. The EPA has also determined that CARB has satisfied the schedule and procedural requirements for data exclusion.

ENCLOSURE: TECHNICAL SUPPORT DOCUMENT FOR EPA CONCURRENCE ON O_3 EXCEEDANCES MEASURED IN TUSCAN BUTTES (TEHAMA COUNTY), CALIFORNIA ON JULY 27, JULY 31-AUGUST 3, AND AUGUST 7-10, 2018 AS AN EXCEPTIONAL EVENT

On September 17, 2021, the California Air Resources Board (CARB) submitted an exceptional event demonstration for exceedances of the 2015 8-hour ozone (O_3) National Ambient Air Quality Standards (NAAQS) of 0.075 parts per million (ppm) that occurred at the Tuscan Buttes monitoring site on July 27, July 31-August 3, and August 7-10, 2018.[1] The demonstration submitted by CARB stated that the exceedances measured between July 27 and August 10, 2018 were caused by multiple wildfires burning in Northern California, most significantly the Carr and Mendocino Complex (i.e., Ranch and River) fires.[2] Under the Exceptional Events Rule, air agencies can request the exclusion of event-influenced data, and the EPA can agree to exclude these data, from the data set used for certain regulatory decisions. The remainder of this document summarizes the Exceptional Events Rule requirements, the event and the EPA's review process.

EXCEPTIONAL EVENTS RULE REQUIREMENTS

The EPA promulgated the Exceptional Events Rule in 2007, pursuant to the 2005 amendment of Clean Air Act (CAA) Section 319. In 2016, the EPA finalized revisions to the Exceptional Events Rule. The 2007 Exceptional Events Rule and 2016 Exceptional Events Rule revisions added sections 40 CFR §50.1(j)-(r); §50.14; and §51.930 to title 40 of the Code of Federal Regulations (CFR). These sections contain definitions, criteria for EPA approval, procedural requirements, and requirements for air agency demonstrations. The EPA reviews the information and analyses in the air agency's demonstration package using a weight of evidence approach and decides to concur or not concur. The demonstration must satisfy all of the Exceptional Events Rule criteria for the EPA to concur with excluding the air quality data from regulatory decisions.

Under 40 CFR §50.14(c)(3)(iv), the air agency demonstration to justify exclusion of data must include:

A. "A narrative conceptual model that describes the event(s) causing the exceedance or violation and a discussion of how emissions from the event(s) led to the exceedance or violation at the affected monitor(s);"

B. "A demonstration that the event affected air quality in such a way that there exists a clear causal relationship between the specific event and the monitored exceedance or violation;"

[1] "Exceptional Events Demonstration for Ozone Exceedances; Northern California; July-August 2018 Wildfire Events ", (September 17, 2021) ("demonstration"). The demonstration addresses multiple events and exceedances measured in Northern California in July – August 2018. The EPA's evaluation of the information presented in the demonstration is reflected in seven separate TSDs, grouped by nonattainment area affected.

[2] See demonstration, p. 40.

C. "Analyses comparing the claimed event-influenced concentration(s) to concentrations at the same monitoring site at other times" to support requirement (B) above;

D. "A demonstration that the event was both not reasonably controllable and not reasonably preventable;" and

E. "A demonstration that the event was a human activity that is unlikely to recur at a particular location or was a natural event."[3]

In addition, the air agency must meet several procedural requirements, including:

1. submission of an Initial Notification of Potential Exceptional Event and flagging of the affected data in the EPA's Air Quality System (AQS) as described in 40 CFR §50.14(c)(2)(i),

2. completion and documentation of the public comment process described in 40 CFR §50.14(c)(3)(v), and

3. implementation of any relevant mitigation requirements as described in 40 CFR §51.930.

For data influenced by exceptional events to be excluded from use in initial area designations, air agencies must also meet the initial notification and demonstration submission deadlines specified in Table 2 to 40 CFR §50.14. We include below a summary of the Exceptional Events Rule criteria, including those identified in 40 CFR §50.14(c)(3)(iv).

Regulatory Significance

The 2016 Exceptional Events Rule includes regulatory language that applies the provisions of CAA section 319 to a specific set of regulatory actions. As identified in 40 CFR §50.14(a)(1)(i), these regulatory actions include initial area designations and redesignations; area classifications; attainment determinations (including clean data determinations); attainment date extensions; findings of State Implementation Plan (SIP) inadequacy leading to a SIP call; and other actions on a case-by-case basis as determined by the Administrator. Air agencies and the EPA should discuss the regulatory significance of an exceptional events demonstration during the Initial Notification of Potential Exceptional Event prior to the air agency submitting a demonstration for the EPA's review.

Narrative Conceptual Model

The 2016 Exceptional Events Rule directs air agencies to submit, as part of the demonstration, a narrative conceptual model of the event that describes and summarizes the event in question and provides context for analyzing the required statutory and regulatory technical criteria. Air agencies may support the narrative conceptual model with summary tables or maps. For wildfire O_3 events, the EPA recommends that the narrative conceptual model also discuss the interaction

[3] A natural event is further described in 40 CFR 50.1(k) as "an event and its resulting emissions, which may recur at the same location, in which human activity plays little or no direct causal role. For purposes of the definition of a natural event, anthropogenic sources that are reasonably controlled shall be considered to not play a direct role in causing emissions."

of emissions, meteorology, and chemistry of event and non-event O_3 formation in the area, and, under 40 CFR §50.14(a)(1)(i), must describe the regulatory significance of the proposed data exclusion.

Clear Causal Relationship and Supporting Analyses

The EPA considers a variety of evidence when evaluating whether there is a clear causal relationship between a specific event and the monitored exceedance or violation. For wildfire O_3 events, air agencies should compare the O_3 data requested for exclusion with seasonal and annual historical concentrations at the air quality monitor to establish a clear causal relationship between the event and monitored data. In addition to providing this information on the historical context for the event-influenced data, air agencies should further support the clear causal relationship criterion by demonstrating that the wildfire's emissions were transported to the monitor, that the emissions from the wildfire influenced the monitored concentrations, and, in some cases, air agencies may need to provide evidence of the contribution of the wildfire's emissions to the monitored O_3 exceedance or violation.

For wildfire O_3 events, the EPA has published a guidance document that provides three different tiers of analyses that apply to the "clear causal relationship" criterion within an air agency's exceptional events demonstration.[4] This tiered approach recognizes that some wildfire events may be more clear and/or extreme and, therefore, require relatively less evidence to satisfy the rule requirements. If a wildfire/O_3 event satisfies the key factors for either Tier 1 or Tier 2 clear causal analyses, then those analyses are the only analyses required to support the clear causal relationship criterion within an air agency's demonstration for that particular event. Other wildfire/O_3 events will be considered based on Tier 3 analyses.

- Tier 1: Wildfires that clearly influence monitored O_3 exceedances or violations when they occur in an area that typically experiences lower O_3 concentrations.
    - *Key Factor*: seasonality and/or distinctive level of the monitored O_3 concentration. The event-related exceedance occurs during a time of year that typically has no exceedances, or is clearly distinguishable (*e.g.*, 5-10 parts per billion (ppb) higher) from non-event exceedances.
    - In these situations, O_3 impacts should be accompanied by clear evidence that the wildfire's emissions were transported to the location of the monitor.

- Tier 2: The wildfire event's O_3 influences are higher than non-event related concentrations, and fire emissions compared to the fire's distance from the affected monitor indicate a clear causal relationship.
    - *Key Factor 1*: fire emissions and distance of fire(s) to affected monitoring site location(s). Calculated fire emissions of nitrogen oxides (NO_x) and reactive-volatile organic compounds (VOC) in tons per day (Q) divided by the distance from the fire to the monitoring site (D) should be equal to or greater than 100 tons per day/kilometers ($Q/D \geq 100$ tpd/km). The guidance document provides additional information on the calculation of Q/D.

[4] "Guidance on the Preparation of Exceptional Events Demonstrations for Wildfire Events that May Influence Ozone Concentrations" (September 2016) ("wildfire O_3 guidance document).

- *Key Factor 2*: comparison of the event-related O_3 concentration with non-event related high O_3 concentrations. The exceedance due to the exceptional event:
  - is in the 99th or higher percentile of the 5-year distribution of O_3 monitoring data, OR
  - is one of the four highest O_3 concentrations within 1 year (among those concentrations that have not already been excluded under the Exceptional Events Rule, if any).
- In addition to the analysis required for Tier 1, the air agency should supply additional evidence to support the weight of evidence that emissions from the wildfire affected the monitored O_3 concentration.

- Tier 3: The wildfire does not fall into the specific scenarios (i.e., does not meet the key factors) that qualify for Tier 1 or Tier 2, but the clear causal relationship criterion can still be satisfied by a weight of evidence showing.
  - In addition to the analyses required for Tier 1 and Tier 2, an air agency may further support the clear causal relationship with additional evidence that the fire emissions caused the O_3 exceedance.

Not Reasonably Controllable or Preventable

The Exceptional Events Rule requires that air agencies establish that the event be both not reasonably controllable and not reasonably preventable at the time the event occurred. This requirement applies to both natural events and events caused by human activities; however, it is presumed that wildfires on wildland will satisfy both factors of the "not reasonably controllable or preventable" element unless evidence in the record clearly demonstrates otherwise.[5]

Natural Event

According to the CAA and the Exceptional Events Rule, an exceptional event must be "an event caused by human activity that is unlikely to recur at a particular location *or* a natural event" (emphasis added). The 2016 Exceptional Events Rule includes in the definition of wildfire that "[a] wildfire that predominantly occurs on wildland is a natural event." Once an agency provides evidence that a wildfire on wildland occurred and demonstrates that there is a clear causal relationship between the measurement under consideration and the event, the EPA expects minimal documentation to satisfy the "human activity that is unlikely to recur at a particular location or a natural event" element. The EPA will address wildfires on other lands on a case-by-case basis.

EPA REVIEW OF EXCEPTIONAL EVENTS DEMONSTRATION

On March 16, 2021, CARB submitted an Initial Notification of a potential Exceptional Event for nine exceedances of the 2015 8-hour O_3 NAAQS that occurred at the Tuscan Butte monitoring site

[5] A wildfire is defined in 40 CFR 50.1(n) as "any fire started by an unplanned ignition caused by lightning; volcanoes; other acts of nature; unauthorized activity; or accidental, human-caused actions, or a prescribed fire that has developed into a wildfire. A wildfire that predominantly occurs on wildland is a natural event." Wildland is defined in 40 CFR 50.1(o) as "an area in which human activity and development are essentially non-existent, except for roads, railroads, power lines, and similar transportation facilities. Structures, if any, are widely scattered."

within Tehama County, California between July 27 and August 10, 2018.[6] On September 17, 2021, CARB submitted an exceptional event demonstration for nine exceedances of the 2015 8-hour O_3 NAAQS that occurred at the Tuscan Butte monitoring site within Tehama County, California between July 27 and August 10, 2018.[7]

Regulatory Significance

The EPA determined that data exclusion of certain exceedances referenced in the Initial Notification may have a regulatory significance for the determination of attainment by the attainment date for the Tuscan Butte (Tehama County), California Marginal nonattainment area for the 2015 8-hour O_3 NAAQS and worked with CARB to identify the relevant exceedances and monitoring sites affected.[8] Table 1 summarizes the exceedances measured at the Tuscan Butte monitoring site that CARB included in the demonstration.

Table 1: 2015 8-hour O_3 NAAQS Exceedance Summary

Exceedance Date	Monitoring Site Name	AQS ID	2015 8-hour Avg. (ppm)
July 27, 2018	Tuscan Butte	06-103-0004	0.076
July 31, 2018	Tuscan Butte	06-103-0004	0.081
August 1, 2018	Tuscan Butte	06-103-0004	0.082
August 2, 2018	Tuscan Butte	06-103-0004	0.073
August 3, 2018	Tuscan Butte	06-103-0004	0.077
August 7, 2018	Tuscan Butte	06-103-0004	0.071
August 8, 2018	Tuscan Butte	06-103-0004	0.078
August 9, 2018	Tuscan Butte	06-103-0004	0.087
August 10, 2018	Tuscan Butte	06-103-0004	0.085

Narrative Conceptual Model

The demonstration submitted by CARB provided a narrative conceptual model in the "Overview/Introduction," "Background," and "Narrative Conceptual Model" chapters to describe how emissions and smoke from a very active fire season in 2018 blew downwind, blanketing vast portions of Northern California during the period of July 26 to August 10, 2018. The demonstration specifically identified the Carr, River, and Ranch wildfires as the most influential fires that caused the O_3 exceedances at the Tuscan Butte monitoring site.[9] The narrative conceptual model addresses the regulatory significance of the exceptional event by stating that the exclusion of wildfire events in 2018 and 2020 would affect the determination of attainment for the Tuscan Buttes (Tehama County), California Marginal nonattainment area for the 2015 O_3 NAAQS.[10]

The "Overview/Introduction" and "Background" sections of the demonstration provided information supporting the narrative conceptual model included characteristics of the nonattainment area, such as geography, topography, meteorology, the ambient O_3 monitoring

[6] See email from Sylvia Vanderspek, CARB, to Gwen Yoshimura, EPA Region 9, dated March 16, 2021.
[7] See letter from Michael Benjamin, CARB, to Elizabeth Adams, EPA Region 9, dated September 17, 2021.
[8] See letter from Elizabeth Adams, EPA Region 9, to Sylvia Vanderspek, CARB, dated April 21, 2021.
[9] See demonstration, p. 69-70.
[10] See demonstration, pp. 2, 71.

network, descriptions of typical O_3 formation emissions, and seasonal O_3 variations.[11] The Background chapter described the Tuscan Buttes region and explained that Tehama County is located in the north central portion of California and is part of the Sacramento Valley Air Basin bounded on the north, west, and east by mountain ranges which can reach heights in excess of 6,000 feet above mean sea level. The mountains provide a substantial barrier to both locally created pollution and the pollution that has been transported northward on prevailing winds from the Broader Sacramento Area. Although there is a lack of emission sources in the Tuscan Buttes nonattainment area, the northern portion of the Air Basin is shaped like an elongated bowl, with temperature inversion layers that can act as a lid, allowing air pollution to rise to unhealthy levels. The Tuscan Butte monitor was sited for high-elevation transport study, and the Tuscan Buttes nonattainment area is limited to the portion of the Tuscan Buttes above 1,800 feet.[12]

The narrative conceptual model described event related characteristics and indicated that the observed exceedances were caused by emissions from multiple wildfires in Northern California, and that the exceedances qualify as exceptional events. The demonstration provided a summary of each wildfire event between July 26 and August 10, 2018, including a detailed table for actively burning wildfires in Northern California during the time of the exceedances that included fire start and end dates, daily and total acres burned, and maps of the fire perimeters and affected monitors.[13] The narrative conceptual model also included figures displaying meteorological conditions on the dates of the fires and Hybrid Single Particle Lagrangian Integrated Trajectory (HYSPLIT) modeling results. The HYSPLIT trajectory modeling results were presented with satellite imagery, National Oceanic and Atmospheric Administration (NOAA) Hazard and Mapping System (HMS) satellite-derived smoke layers, and meteorological analyses to support that wildfire emissions were transported to the Tuscan Butte monitoring site on the exceptional event dates requested for exclusion. Along with these graphics, the narrative conceptual model included narrative descriptions of how meteorological conditions affected the behavior of air and smoke in the areas of the wildfires on July 26-29, July 30-31, August 1-2, August 6-9, and August 10-11, 2018.[14]

Tables 3-15 and 3-16 in the demonstration showed the averages and standard deviations of temperatures and wind speeds, respectively, at the Tuscan Butte monitoring site from July to August 2018.[15] Table 3-21 showed the 1-hour and 8-hour O_3 concentrations, temperatures, and wind speed at the Tuscan Butte monitoring site on each exceptional event day.[16] A comparison of the exceptional event day temperatures and wind speeds to the average values and standard deviations from July 2018-August 2018 indicate that weather patterns observed at the Tuscan Butte monitoring site on exceptional event days were not more favorable for O_3 formation than on non-event days. The demonstration concluded that O_3 directly related to wildfire smoke influenced the exceedances as opposed to unusual weather.

The narrative conceptual model included descriptions of air quality advisories issued, stating that, "[al]though the Tehama County APCD [Air Pollution Control District] does not host a

[11] See demonstration, pp. 15-19, 24, 26.
[12] See demonstration, pp. 15-16.
[13] See demonstration, pp. 27-40.
[14] See demonstration, pp. 40-61.
[15] See demonstration, p. 74.
[16] See demonstration, pp. 77-78.

webpage specifically dedicated to wildfire smoke impacts, the public is kept informed via their current air quality information page as well as their news and events page. Air quality advisories are prominently displayed on the District's main webpage." [17] Appendix II part E includes additional air quality/health advisories that were issued and media coverage during this event.[18]

Based on the information described above, the demonstration submitted by CARB meets the narrative conceptual model criterion of the Exceptional Events Rule (EER).

Table 2: Documentation of the Narrative Conceptual Model

Exceedance Date	Demonstration Citation	Quality of Evidence	Criterion Met?
July 27, July 31-August 3, August 7-10, 2018	"Overview/Introduction": pp. 1-4 "Background": pp. 15-19, 24, 26 "Narrative Conceptual Model": pp. 27-61, 69-71, 74, 77-80 Appendix II-E: pp. 196-210	Sufficient	Yes

Clear Causal Relationship

The demonstration included several analyses to support a clear causal relationship between the wildfire event and the monitored exceedances. These analyses are presented in the "Clear Casual Relationship" chapter.[19]

Comparison with historical concentrations

The demonstration included a comparison with historical concentrations, as required by 40 CFR §50.14(c)(3)(iv)(C). The demonstration compared O_3 concentrations at the Tuscan Butte monitoring site on the 2018 exceptional event days to historical non-event O_3 concentrations from 2013-2018. This included a graph of daily maximum 8-hour average concentrations over the six-year period by day of year, along with the level of the NAAQS and the 99th percentile value at the site. The demonstration noted that the exceptional events occurred during the time of year when O_3 concentrations tend to be higher at this monitoring site and that the exceptional event exceedances at the Tuscan Butte monitoring site are not clearly distinguishable from non-event exceedances as defined by guidance.[20]

Tier 1: Key Factor

To meet the key factor for a Tier 1 analysis, exceedances should be clearly higher than other non-event related exceedances or occur during a time of year that typically experiences no exceedances. The exceedances identified in the demonstration occurred during the time of year where O_3 concentrations tend to be higher at the monitoring site, and that these exceedances do not exceed non-event concentrations by at least 5 ppb.[21] Therefore, the event exceedances do not meet the Tier 1 Key Factor, and additional evidence beyond a Tier 1 analysis is needed to support the clear causal relationship.

[17] See demonstration, pp. 79-80.
[18] See demonstration, Appendix II-E, pp. 196-210.
[19] See demonstration, pp. 83-144.
[20] See demonstration, pp. 83-84, 89.
[21] See demonstration, p. 89.

Tier 2: Key Factors

The demonstration included an evaluation of the Tier 2 Key Factors.[22] For Tier 2 Key Factor 1, the demonstration provided an analysis of fire emissions (Q) and distance (D) of the wildfires to the monitoring site locations. The Q/D value is generally calculated by dividing wildfire emissions (in tons per day) by the distance between the wildfire and the monitoring site (in kilometers [km]). Daily Q/D values were calculated by the EPA using daily wildland fire emissions input files originally created for the Community Multiscale Air Quality (CMAQ) modeling system. The resulting calculations were shared with CARB to assist in demonstration development. CMAQ input files included daily total emissions of nitrogen oxide (NO), nitrogen dioxide (NO_2), and reactive organic gases (ROG) at release points corresponding to wildfire locations. Q/D was calculated for each CMAQ input release point by calculating the distance between release point locations and gridded receptor locations and dividing the associated fire's daily total emissions by this distance. An aggregated daily Q/D was then calculated by summing the individual Q/D values for each release point. An "effective Q/D" value was then calculated at monitoring site receptor locations by accounting for periods where multiple days of wildfire smoke buildup impacted the monitoring site for up to three total days; the dates to include in each daily "effective Q/D" was based on meteorology and transport analyses, with the rationale further outlined in the demonstration.[23] The Q/D analysis for the Tuscan Butte monitoring site was inadvertently omitted from the original submittal but was provided in a subsequent submittal.[24] This later submittal included both the "daily Q/D" and the "effective Q/D" for the exceedance days in attachment A to the letter, Table 4-A. The effective distance weighted sum for all the dates requested as exceptional events at the Tuscan Butte monitoring site, except August 10, 2018, are greater than the Tier 2 Key Factor 1 screening value of 100 tons per day of NO_x and VOC per km. Therefore, all event exceedances except August 10, 2018, meet the Tier 2 Key Factor 1. The submission noted that enhanced wildfire impacts for August 10, 2018 are also considered qualifying because they occurred at the end of a prolonged event; wildfire emissions were decreasing but remained elevated, and residual local effects continued to impact O_3 concentrations at the monitoring site.[25] Since all of the dates but one meet Tier 2 Key Factor 1, and the date that does not follows several days of requested exclusions that do meet the Key Factor, it is appropriate to consider all days included in the demonstration as meeting Tier 2 Key Factor 1 for the purposes of determining the appropriate tier for this demonstration.

For Tier 2 Key Factor 2, the demonstration included evidence that the exceedances, including August 10, 2018, are at or above the 99th percentile from the past five years of O_3 season data (2013-2017) or are among the adjusted four highest concentrations measured at the site in 2018. In the demonstration CARB determined an "adjusted 4th high" corresponding to the 4th highest non-event exceedance monitored in 2018, excluding the exceedances included in the demonstration. CARB stated that dates impacted by exceptional events should not count against the tally of the four highest O_3 concentrations measured in 2018 because these exceedances were caused by contributions from wildfire emissions.[26] This rationale is supported given that the purpose of the test is to show that the exceedances are high compared to non-event data. Since the excluded dates are all included in the demonstration being evaluated in this technical support

[22] See demonstration, p. 90.
[23] See demonstration, pp. 92-93.
[24] See letter from Sylvia Vanderspek, CARB, to Gwen Yoshimura, EPA, dated December 7, 2021.
[25] Id.
[26] See demonstration, pp. 98-99.

document, each individual date would not count towards the four highest concentrations if concurred on by the EPA. Table 4-10 of the demonstration included the top 20 max daily 8-hour O_3 concentrations measured at Tuscan Buttes in 2018. The table shows that all the dates requested as exceptional events, including August 10, 2018 are at or above the adjusted 4th high O_3 concentration.[27] Therefore, the event exceedances meet Tier 2 Key Factor 2.

Based on the analysis of the Key Factors for Tier 2, the EPA's wildfire O_3 guidance document indicates that a Tier 2 analysis is appropriate for this event. As described below, the demonstration included the required elements for a Tier 2 clear causal relationship analysis based on the EPA's wildfire O_3 guidance document. This includes evidence to support that (1) wildfire emissions were transported from the wildfire to the monitor; and (2) wildfire emissions affected the monitor.

Evidence of transport of wildfire emissions from the wildfire to the monitor

The demonstration presented analyses in the Narrative Conceptual Model chapter and Appendix IV using backward trajectory and forward trajectory modeling. HYSPLIT modeling was used to determine back trajectories and forward trajectories that estimate the movement of air parcels and smoke during the event time period.[28] HYSPLIT back trajectories initiated from the monitor location show the likely path of air parcels for 36 hours prior to the time of peak concentrations on July 27, August 1, August 3, August 7, and August 10 of 2018 at three elevations (100 meters (m), 500 m, and 1,000 m), and were overlaid on NOAA HMS Fire and Smoke Product imagery.[29] HYSPLIT forward trajectories showing the most likely center path of air parcels for 36 hours beginning at the wildfire locations on July 27, August 1, August 7, and August 10 of 2018 were overlaid on satellite imagery to provide a visual analysis of whether smoke emitted from the fires may have impacted ambient O_3 concentrations at the Tuscan Butte monitoring site.[30] Additional HYSPLIT forward and backward trajectories for the time period of the event are included in Appendix IV.[31] Overall, these model results showed the impacts from the wildfires in California dispersed throughout the northern and central portions of the State. The back trajectories from the Tuscan Butte monitoring site pass near the fire locations and areas of heavy smoke, while the forward trajectories approach the monitoring site. The back trajectory and forward trajectory analyses support that wildfire emissions were transported to the Tuscan Butte monitoring site on the days requested for exclusion as exceptional events.

Evidence that the wildfire emissions affected the monitor

The demonstration provided 1-hour O_3 diurnal profiles for the Tuscan Butte monitoring site for each exceedance day and compared them with the hourly diurnal percentiles for O_3 from 2013-2017.[32] Due to an equipment malfunction, there is no data for parts of the days on July 25 to July 31, 2018 for this monitoring site. However, for the diurnal profiles that are included in Figures 4-46 through 4-54, hourly O_3 concentrations generally follow the normal patterns and are sustained

[27] See demonstration, p. 103.
[28] See demonstration, pp. 42-61, Appendix IV, pp. 241-307, 320-323.
[29] See demonstration, pp. 45, 48, 55, 58, 61.
[30] See demonstration, pp. 44, 50, 54, 57, 60.
[31] See demonstration, Appendix IV, pp. 241-307, 320-323
[32] See demonstration, pp. 125-129.

around the 95th percentile concentrations, with peak O_3 concentrations (typically between the 13th and 19th hour) well above the 95th percentile for those days.

The demonstration also provided $PM_{2.5}$ analysis. Since the Tuscan Butte monitoring site does not monitor for $PM_{2.5}$, monitoring data from the Red Bluff monitoring site, 10 miles southwest of the Tuscan Butte monitoring site, was used. Figure 3-39 shows the 1-hour O_3 concentrations and 1-hour $PM_{2.5}$ concentrations measured at the Tuscan Butte and Red Bluff monitoring sites from July 15 through August 15, 2018. Increases in O_3 concentrations at Tuscan Butte and Red Bluff monitoring sites coincide with increases in $PM_{2.5}$ concentrations at Red Bluff monitoring site from July 27 through August 10, 2018. The demonstration concluded that the strong correlation between elevated $PM_{2.5}$ and O_3 on the submitted exceedance days coupled with the meteorological and HYSPLIT data discussed above supports that the exceedances recorded at the Tuscan Butte monitoring site were impacted by smoke and emissions from wildfires in the region. [33]

The demonstration provided analysis on biomass burning indicators which are commonly used as woodsmoke tracers.[34] The demonstration specifically stated that there are monitors that measure these compounds at Portola in Plumas County in the Mountain Counties Air Basin and at Chico and Sacramento-T Street in the Sacramento Valley Air Basin, which aid in the analysis of woodstove use. Although these sites do not consistently monitor during the summer months, they did collect data when first installed in 2007 and were active in the summer of 2018. Figure 4-70 shows the concentrations of levoglucosan, mannosan, and galactoson measured at the three stations between July 1 to August 31, 2018.[35] The two samples collected during the time addressed in this demonstration, July 31, 2018 and August 6, 2018, show concentrations across all three sites that are among the highest concentrations measured during the period in the figures. Figure 4-71 shows a comparison between data collected during a clean period (July 1 through August 31, 2007) and the impacted period from July 1 to August 31, 2018. The average and median concentrations for all three indicators were significantly higher in 2018 compared to 2007 which is an indication of elevated smoke in monitored areas from late July through mid-August 2018.[36] Furthermore, the demonstration provided an analysis of black carbon, noting that wildfires are a major source of black carbon emissions in California.[37] Figure 4-72 includes a map of California overlaid with black carbon smoke plumes associated with the Carr, Mendocino, and Ferguson Fires on August 6, 2018. The map shows high concentrations of atmospheric black carbon over the Mendocino Complex wildfire, near Tehama County, which supports evidence of wildfire smoke in Tuscan Buttes during the time of the exceedances.

As additional evidence to support that wildfire emissions affected the Tuscan Butte monitoring site, the demonstration included the following information: (1) NWS area forecast discussions from the Sacramento office describing increased day time smoke, (2) NOAA Smoke Text Products on July 26 and August 5, 2018 discussing thick smoke accumulating in the Sacramento and San Joaquin Valleys from the Ferguson and Carr fires, and (3) air quality advisories issued

[33] See demonstration, p. 70.
[34] See demonstration, p. 138.
[35] See demonstration, p. 139.
[36] See demonstration, p. 140.
[37] See demonstration, pp. 140-141.

by Tehama County between July 26 and August 10, 2018.[38] These analyses and associated information support the weight of evidence that smoke was observed at ground level and affected O_3 measured at the monitor.

Conclusion

The analyses included in the demonstration, specifically comparison to historical concentrations, Tier 2 Key Factors including Q/D analyses, HYSPLIT modeling and satellite observations of smoke, correlation between $PM_{2.5}$ and O_3 during the event dates, evidence of impacts to hourly O_3 data, presence of biomass burning tracers, and related NWS and NOAA statements on smoke, sufficiently demonstrate a clear causal relationship between the emissions generated by the Carr, River, and Ranch Fires and the exceedances measured at Tuscan Butte monitoring site.

Table 3: Documentation of the Clear Causal Relationship criterion

Exceedance Date	Demonstration Citation	Quality of Evidence	Criterion Met?
July 27, July 31-August 3, August 7-10, 2018	"Narrative Conceptual Model": pp. 40-61, 70, 79-80 "Clear Casual Relationship": pp. 83-144 Appendix II.E: pp. 196-210 Appendix III: pp. 223-238 Appendix IV: pp. 241-307, 320-323 Appendix V: pp. 329-338	Sufficient	Yes

Not Reasonably Controllable or Preventable

The Exceptional Events Rule presumes that wildfire events on wildland are not reasonably controllable or preventable [40 CFR §50.14(b)(4)]. The demonstration provided evidence that the wildfire event meets definition of wildfire [40 CFR§50.1(n)]. Specifically, the demonstration included maps and descriptions of the wildfires, along with figures showing wildfire boundaries overlaid upon land ownership and wildland-urban interface layers to demonstrate that the fires occurred on wildland or in the urban/wildland interface.[39] The demonstration described that CARB is not aware of any evidence clearly demonstrating that prevention or control efforts beyond those actually made would have been reasonable.[40] Therefore, the documentation provided sufficiently demonstrates that the event was not reasonably controllable and not reasonably preventable.

Table 4: Documentation of the Not Reasonably Controllable or Preventable criterion

Exceedance Date	Demonstration Citation	Quality of Evidence	Criterion Met?
July 27, July 31-August 3, August 7-10, 2018	"Narrative Conceptual Model – July 26-August 10, 2018": pp. 27-40 "Not Reasonably Controllable and/or Not Reasonably Preventable": p. 145	Sufficient	Yes

[38] See demonstration, pp. 141-144, Appendices II-E, III-B, C, V pp. 196-210, 223-238, 329-338.
[39] See demonstration, pp. 27-40.
[40] See demonstration, p. 145.

Natural Event

The definition of "wildfire" at 40 CFR §50.1(n) states, "A wildfire that predominantly occurs on wildland is a natural event." As previously described, the demonstration included documentation that the event meets the definition of a wildfire and occurred predominantly on wildland and has therefore shown that the event was a natural event.

Table 5: Documentation of the Natural Event criterion

Exceedance Date	Demonstration Citation	Quality of Evidence	Criterion Met?
July 27, July 31-August 3, August 7-10, 2018	"Narrative Conceptual Model – July 26-August 10, 2018": pp. 27-40 "Natural Event/Human Activity Unlikely to Recur": p. 145	Sufficient	Yes

Schedule and Procedural Requirements

In addition to technical demonstration requirements, 40 CFR §50.14(c) and 40 CFR §51.930 specify schedule and procedural requirements an air agency must follow to request data exclusion. Table 6 outlines the EPA's evaluation of these requirements.

Table 6: Schedules and Procedural Criteria

	Reference	Demonstration Citation	Criterion Met?
Did the agency provide prompt public notification of the event?	40 CFR § 50.14 (c)(1)(i)	"Narrative Conceptual Model – July 26-August 10, 2018": pp. 79-80 Appendix II-E: pp. 196-210	Yes
Did the agency submit an Initial Notification of Potential Exceptional Event and flag the affected data in the EPA's Air Quality System (AQS)?	40 CFR § 50.14 (c)(2)(i)	Appendix I-E: pp. 162-163	Yes
Did the initial notification and demonstration submittals meet the deadlines for data influenced by exceptional events for use in initial area designations, if applicable? Or the deadlines established by the EPA during the Initial Notification of Potential Exceptional Events process, if applicable?	40 CFR § 50.14 Table 2 40 CFR § 50.14 (c)(2)(i)(B)	Letter from Gwen Yoshimura, EPA R9, to Sylvia Vanderspek, CARB, dated April 21, 2021	Yes

	Reference	Demonstration Citation	Criterion Met?
Was the public comment process followed and documented? • Did the agency document that the comment period was open for a minimum of 30 days? • Did the agency submit to the EPA any public comments received? • Did the state address comments disputing or contradicting factual evidence provided in the demonstration?	40 CFR § 50.14 (c)(3)(v)	Letter from Michael Benjamin, CARB, to Elizabeth Adams, EPA R9, dated October 28, 2021	Yes
Has the agency met requirements regarding submission of a mitigation plan, if applicable?	40 CFR § 51.930 (b)	NA	NA

Conclusion

The EPA has reviewed the documentation provided by CARB to support claims that smoke from the Carr Fire and the Mendocino Complex Fire (i.e., Ranch and River fires) in Northern California caused numerous exceedances of the 2015 8-hour O_3 NAAQS at the Tuscan Butte monitoring site between July 27 and August 10, 2018. The EPA has determined that the flagged exceedances at the Tuscan Butte monitoring site on these days satisfies the exceptional event criteria: the event was a natural event, which affected air quality in such a way that there exists a clear causal relationship between the event and the monitored exceedances and was not reasonably controllable or preventable. The EPA has also determined that CARB has satisfied the schedule and procedural requirements for data exclusion.

ENCLOSURE: TECHNICAL SUPPORT DOCUMENT FOR EPA CONCURRENCE ON O_3 EXCEEDANCES MEASURED IN THE EASTERN PART OF SAN LUIS OBISPO COUNTY, CALIFORNIA ON AUGUST 3-4, AUGUST 6-7, AND AUGUST 9, 2018 AS AN EXCEPTIONAL EVENT

On September 3, 2021, the California Air Resources Board (CARB) submitted an exceptional event demonstration for exceedances of the 2015 8-hour ozone (O_3) National Ambient Air Quality Standards (NAAQS) of 0.070 parts per million (ppm) that occurred at the Red Hills monitoring site on August 3-4, August 6-7, and August 9, 2018.[1] The demonstration submitted by CARB stated that the exceedances measured between August 3 and August 9, 2018 were caused by numerous wildfires burning in California and Southern Oregon, namely the Mendocino Complex (Ranch and River fires), Natchez, Carr, Donnell, Ferguson, and Turkey Fires, as well as the Klondike and Taylor Creek Fires in Southern Oregon.[2] Under the Exceptional Events Rule, air agencies can request the exclusion of event-influenced data, and the EPA can agree to exclude these data, from the data set used for certain regulatory decisions. The remainder of this document summarizes the Exceptional Events Rule requirements, the event and the EPA's review process.

EXCEPTIONAL EVENTS RULE REQUIREMENTS

The EPA promulgated the Exceptional Events Rule in 2007, pursuant to the 2005 amendment of Clean Air Act (CAA) Section 319. In 2016, the EPA finalized revisions to the Exceptional Events Rule. The 2007 Exceptional Events Rule and 2016 Exceptional Events Rule revisions added sections 40 CFR §50.1(j)-(r); §50.14; and §51.930 to title 40 of the Code of Federal Regulations (CFR). These sections contain definitions, criteria for EPA approval, procedural requirements, and requirements for air agency demonstrations. The EPA reviews the information and analyses in the air agency's demonstration package using a weight of evidence approach and decides to concur or not concur. The demonstration must satisfy all of the Exceptional Events Rule criteria for the EPA to concur with excluding the air quality data from regulatory decisions.

Under 40 CFR §50.14(c)(3)(iv), the air agency demonstration to justify exclusion of data must include:

A. "A narrative conceptual model that describes the event(s) causing the exceedance or violation and a discussion of how emissions from the event(s) led to the exceedance or violation at the affected monitor(s);"

B. "A demonstration that the event affected air quality in such a way that there exists a clear causal relationship between the specific event and the monitored exceedance or violation;"

[1] "Exceptional Events Demonstration for Ozone Exceedances Eastern Portion of San Luis Obispo County, California August 2018 Wildfire Events," (September 2021) ("demonstration"). The demonstration addresses multiple events and exceedances measured in Northern California in July – August 2018. The EPA's evaluation of the information presented in the demonstration is reflected in eight separate TSDs, grouped by nonattainment area affected.

[2] See demonstration, pp. 16-17.

C. "Analyses comparing the claimed event-influenced concentration(s) to concentrations at the same monitoring site at other times" to support requirement (B) above;

D. "A demonstration that the event was both not reasonably controllable and not reasonably preventable;" and

E. "A demonstration that the event was a human activity that is unlikely to recur at a particular location or was a natural event."[3]

In addition, the air agency must meet several procedural requirements, including:

1. submission of an Initial Notification of Potential Exceptional Event and flagging of the affected data in the EPA's Air Quality System (AQS) as described in 40 CFR §50.14(c)(2)(i),

2. completion and documentation of the public comment process described in 40 CFR §50.14(c)(3)(v), and

3. implementation of any relevant mitigation requirements as described in 40 CFR §51.930.

For data influenced by exceptional events to be excluded from use in initial area designations, air agencies must also meet the initial notification and demonstration submission deadlines specified in Table 2 to 40 CFR §50.14. We include below a summary of the Exceptional Events Rule criteria, including those identified in 40 CFR §50.14(c)(3)(iv).

Regulatory Significance

The 2016 Exceptional Events Rule includes regulatory language that applies the provisions of CAA section 319 to a specific set of regulatory actions. As identified in 40 CFR §50.14(a)(1)(i), these regulatory actions include initial area designations and redesignations; area classifications; attainment determinations (including clean data determinations); attainment date extensions; findings of State Implementation Plan (SIP) inadequacy leading to a SIP call; and other actions on a case-by-case basis as determined by the Administrator. Air agencies and the EPA should discuss the regulatory significance of an exceptional events demonstration during the Initial Notification of Potential Exceptional Event prior to the air agency submitting a demonstration for the EPA's review.

Narrative Conceptual Model

The 2016 Exceptional Events Rule directs air agencies to submit, as part of the demonstration, a narrative conceptual model of the event that describes and summarizes the event in question and provides context for analyzing the required statutory and regulatory technical criteria. Air agencies may support the narrative conceptual model with summary tables or maps. For wildfire O_3 events, the EPA recommends that the narrative conceptual model also discuss the interaction

[3] A natural event is further described in 40 CFR 50.1(k) as "an event and its resulting emissions, which may recur at the same location, in which human activity plays little or no direct causal role. For purposes of the definition of a natural event, anthropogenic sources that are reasonably controlled shall be considered to not play a direct role in causing emissions."

of emissions, meteorology, and chemistry of event and non-event O_3 formation in the area, and, under 40 CFR §50.14(a)(1)(i), must describe the regulatory significance of the proposed data exclusion.

Clear Causal Relationship and Supporting Analyses

The EPA considers a variety of evidence when evaluating whether there is a clear causal relationship between a specific event and the monitored exceedance or violation. For wildfire O_3 events, air agencies should compare the O_3 data requested for exclusion with seasonal and annual historical concentrations at the air quality monitor to establish a clear causal relationship between the event and monitored data. In addition to providing this information on the historical context for the event-influenced data, air agencies should further support the clear causal relationship criterion by demonstrating that the wildfire's emissions were transported to the monitor, that the emissions from the wildfire influenced the monitored concentrations, and, in some cases, air agencies may need to provide evidence of the contribution of the wildfire's emissions to the monitored O_3 exceedance or violation.

For wildfire O_3 events, the EPA has published a guidance document that provides three different tiers of analyses that apply to the "clear causal relationship" criterion within an air agency's exceptional events demonstration.[4] This tiered approach recognizes that some wildfire events may be more clear and/or extreme and, therefore, require relatively less evidence to satisfy the rule requirements. If a wildfire/O_3 event satisfies the key factors for either Tier 1 or Tier 2 clear causal analyses, then those analyses are the only analyses required to support the clear causal relationship criterion within an air agency's demonstration for that particular event. Other wildfire/O_3 events will be considered based on Tier 3 analyses.

- Tier 1: Wildfires that clearly influence monitored O_3 exceedances or violations when they occur in an area that typically experiences lower O_3 concentrations.
    - *Key Factor*: seasonality and/or distinctive level of the monitored O_3 concentration. The event-related exceedance occurs during a time of year that typically has no exceedances, or is clearly distinguishable (*e.g.*, 5-10 parts per billion (ppb) higher) from non-event exceedances.
    - In these situations, O_3 impacts should be accompanied by clear evidence that the wildfire's emissions were transported to the location of the monitor.

- Tier 2: The wildfire event's O_3 influences are higher than non-event related concentrations, and fire emissions compared to the fire's distance from the affected monitor indicate a clear causal relationship.
    - *Key Factor 1*: fire emissions and distance of fire(s) to affected monitoring site location(s). Calculated fire emissions of nitrogen oxides (NO_x) and reactive-volatile organic compounds (VOC) in tons per day (Q) divided by the distance from the fire to the monitoring site (D) should be equal to or greater than 100 tons per day/kilometers ($Q/D \geq 100$ tpd/km). The guidance document provides additional information on the calculation of Q/D.

[4] "Guidance on the Preparation of Exceptional Events Demonstrations for Wildfire Events that May Influence Ozone Concentrations" (September 2016) ("wildfire O_3 guidance document").

- *Key Factor 2*: comparison of the event-related O_3 concentration with non-event related high O_3 concentrations. The exceedance due to the exceptional event:
  - is in the 99th or higher percentile of the 5-year distribution of O_3 monitoring data, OR
  - is one of the four highest O_3 concentrations within 1 year (among those concentrations that have not already been excluded under the Exceptional Events Rule, if any).
- In addition to the analysis required for Tier 1, the air agency should supply additional evidence to support the weight of evidence that emissions from the wildfire affected the monitored O_3 concentration.

- Tier 3: The wildfire does not fall into the specific scenarios (i.e., does not meet the key factors) that qualify for Tier 1 or Tier 2, but the clear causal relationship criterion can still be satisfied by a weight of evidence showing.
  - In addition to the analyses required for Tier 1 and Tier 2, an air agency may further support the clear causal relationship with additional evidence that the fire emissions caused the O_3 exceedance.

Not Reasonably Controllable or Preventable

The Exceptional Events Rule requires that air agencies establish that the event be both not reasonably controllable and not reasonably preventable at the time the event occurred. This requirement applies to both natural events and events caused by human activities; however, it is presumed that wildfires on wildland will satisfy both factors of the "not reasonably controllable or preventable" element unless evidence in the record clearly demonstrates otherwise.[5]

Natural Event

According to the CAA and the Exceptional Events Rule, an exceptional event must be "an event caused by human activity that is unlikely to recur at a particular location *or* a natural event" (emphasis added). The 2016 Exceptional Events Rule includes in the definition of wildfire that "[a] wildfire that predominantly occurs on wildland is a natural event." Once an agency provides evidence that a wildfire on wildland occurred and demonstrates that there is a clear causal relationship between the measurement under consideration and the event, the EPA expects minimal documentation to satisfy the "human activity that is unlikely to recur at a particular location or a natural event" element. The EPA will address wildfires on other lands on a case-by-case basis.

EPA REVIEW OF EXCEPTIONAL EVENTS DEMONSTRATION

On March 16, 2021, CARB submitted an Initial Notification of a potential Exceptional Event for numerous exceedances of the 2015 8-hour O_3 NAAQS that occurred at the Red Hills monitoring

[5] A wildfire is defined in 40 CFR 50.1(n) as "any fire started by an unplanned ignition caused by lightning; volcanoes; other acts of nature; unauthorized activity; or accidental, human-caused actions, or a prescribed fire that has developed into a wildfire. A wildfire that predominantly occurs on wildland is a natural event." Wildland is defined in 40 CFR 50.1(o) as "an area in which human activity and development are essentially non-existent, except for roads, railroads, power lines, and similar transportation facilities. Structures, if any, are widely scattered."

site within the Eastern Portion of San Luis Obispo County between August 3, 2018 and August 9, 2018.[6] On September 3, 2021 CARB submitted an exceptional event demonstration for five exceedances of the 2015 8-hour O_3 NAAQS that occurred at the Red Hills monitoring site within the Eastern Portion of San Luis Obispo County between August 3, 2018 and August 9, 2018.[7]

Regulatory Significance

The EPA determined that data exclusion of certain exceedances referenced in the Initial Notification may have a regulatory significance for the determination of attainment by the attainment date for the Eastern Portion of San Luis Obispo County, CA Marginal nonattainment area for the 2015 8-hour O_3 NAAQS, and worked with CARB to identify the relevant exceedances and monitoring site affected.[8] Table 1 summarizes the exceedances measured at the Red Hills monitoring site that CARB included in the demonstration.

Table 1: 2015 8-hour O_3 NAAQS Exceedance Summary

Exceedance Date	Monitoring Site Name	AQS ID	2015 8-hour Avg. (ppm)
August 3, 2018	Red Hills	06-079-8005	0.073
August 4, 2018	Red Hills	06-079-8005	0.072
August 6, 2018	Red Hills	06-079-8005	0.071
August 7, 2018	Red Hills	06-079-8005	0.071
August 9, 2018	Red Hills	06-079-8005	0.073

Narrative Conceptual Model

The demonstration submitted by CARB provided a narrative conceptual model in the "Overview/Introduction," "Background," and "Narrative Conceptual Model" chapters to describe how emissions from the Mendocino Complex (i.e., Ranch and River), Natchez, Carr, Donnell, Ferguson, and Turkey fires in California and the Klondike and Taylor Creek fires in Southern Oregon caused the O_3 exceedances at the Red Hills monitoring site. The narrative conceptual model addressed the regulatory significance of the exceptional event by stating that the exclusion of would affect a determination of attainment for the Eastern Portion of San Luis Obispo County, CA nonattainment area for the 2015 O_3 NAAQS.[9]

The "Overview/Introduction" and "Background" sections of the demonstration provide information supporting the narrative conceptual model including characteristics of the surrounding areas of the Red Hills monitoring site, such as descriptions of geography, topography, meteorology, the ambient O_3 monitoring network, typical O_3 formation, and descriptions of wildfire event driven O_3 formation.[10]

The narrative conceptual model described event-related characteristics and indicated that the observed exceedances were caused by emissions from the Mendocino Complex (Ranch and

[6] See email from Sylvia Vanderspek, CARB, to Gwen Yoshimura and Elizabeth Adams, EPA Region 9, dated March 16, 2021.
[7] See letter from Michael Benjamin, CARB, to Elizabeth Adams, EPA Region 9, dated September 3, 2021.
[8] See letter from Elizabeth Adams, EPA Region 9, to Sylvia Vanderspek, CARB, dated August 27, 2021.
[9] See demonstration, p. 49.
[10] See demonstration, pp. 8-16.

River), Natchez, Carr, Donnell, Ferguson, and Turkey Fires in California and the Klondike and Taylor Creek Fires in Southern Oregon and that these exceedances qualify as an exceptional event under the Exceptional Events Rule (EER).[11] This included a general description of the occurrence of wildfires in Northern and Central California and Southern Oregon and specific descriptions of individual wildfires that generated smoke contributing to O_3 exceedances at the Red Hills monitoring site between August 3, 2018, and August 9, 2018, including the name, cause, start date, containment date, location, and total acreage burned for each fire.[12]

The narrative conceptual model presents summaries of each exceedance day, including a table of major wildfires impacting the Red Hills monitor, meteorological conditions, Hybrid Single Particle Lagrangian Integrated Trajectory (HYSPLIT) back trajectory model results presented with satellite imagery and Hazard and Mapping System (HMS) satellite-derived smoke layers.[13] The demonstration explained that specific wildfires impacted the site depending on the day, but generally northerly winds transported wildfire smoke and O_3 precursors from the Mendocino Complex (Ranch and River), Natchez, Carr, Donnell, Ferguson, and Turkey wildfires causing elevated O_3 concentrations at the monitor. Additionally, smoke from the Taylor Creek and Klondike fires in Southern Oregon was transported to the area, adding an additional smoke layer, and likely contributed to O_3 concentrations higher than what would typically be measured over several days.

The narrative conceptual model presents a graph of daily 1-hour O_3 and particulate matter less than or equal to 2.5 microns in aerodynamic diameter ($PM_{2.5}$) concentrations between August 1, 2018 and August 13, 2018 at the Red Hills site and noted that the timing of elevated $PM_{2.5}$ concentrations coincident with elevated O_3 concentrations recorded at the Red Hills monitoring site supports the presence of wildfire smoke in Red Hills.[14] The demonstration also shows a separate graph for the 8-hour O_3 design values and annual 4th high 8-hour average O_3 concentrations at Red Hills from 2009 to 2018 showing trend lines and the 2018 design values with and without potential exceptional events.[15]

Maximum temperatures and wind conditions are also summarized in the narrative conceptual model from August 1, 2018 to August 10, 2018. During this ten-day period, maximum daily temperatures ranged from 88 to 95 degrees Fahrenheit, maximum daily wind speeds generally fell within 14 to 21 miles per hour (mph), while maximum 8-hour O_3 concentrations varied significantly, ranging from 0.044 ppm to 0.073 ppm. The demonstration concluded that the moderate fluctuations in temperature and wind speeds would not have resulted in such varied O_3 concentration measurements throughout the event period, therefore unusual weather was not a contributing factor to the exceptional event. [16]

Based on the information described above, the demonstration submitted by CARB meets the narrative conceptual model criterion of the EER.

[11] See demonstration, pp.16-17.
[12] See demonstration, pp. 16-28.
[13] See demonstration, pp. 28-48.
[14] See demonstration, pp. 48-49.
[15] See demonstration, pp. 49-50.
[16] See demonstration pp. 50- 51.

Table 2: Documentation of the Narrative Conceptual Model

Exceedance Date	Demonstration Citation	Quality of Evidence	Criterion Met?
August 3-4, 2018 August 6-7, 2018 August 9, 2018	"Background": pp. 8-15 "Narrative Conceptual Model – August 3-9, 2018": pp. 16-52	Sufficient	Yes

Clear Causal Relationship

The demonstration included several analyses to support a clear causal relationship between the wildfire event and the monitored exceedances. These analyses are presented in Chapter 4 titled "Clear Casual Relationship" or, in some cases, in Chapter 3 titled "Narrative Conceptual Model."

Comparison with historical concentrations

The demonstration included a comparison with historical concentrations, as required by 40 CFR §50.14(c)(3)(iv)(C). The demonstration compared the event-related O_3 concentrations to historical non-event O_3 concentrations from 2013-2018.[17] The plots and charts provided show that daily maximum 8-hour average O_3 concentrations on August 3, 4, and 9 in 2018 were at or above the five-year 99th percentile of 0.072 ppm for the O_3 season (January through December). The daily maximum 8-hour average O_3 concentrations on August 3, 4 and 9 were in the 99th percentile for 2018, being the highest three concentrations measured that year. Concentrations on August 6 and 7, 2018 fell into the 98th percentile for 2018 and tied for the fourth highest daily maximum 8-hour average O_3 concentration in 2018. The historical concentration plot also shows that this monitor has observed concentrations at or above 0.072 ppm on approximately 20 other occasions in the period from 2013 to 2018, and four of those exceedances were influenced by wildfires.

Tier 1: Key Factor

To meet the key factor for a Tier 1 analysis, exceedances should be clearly higher than other non-event related exceedances, or occur during a time of year that typically experiences no exceedances. The exceedances identified in this demonstration occurred during the regular O_3 season, during times when other exceedances similar in magnitude were measured. Therefore, the event exceedances do not meet the Tier 1 Key Factor, and additional evidence beyond a Tier 1 analysis is needed to support the clear causal relationship.

Tier 2: Key Factors

The demonstration included an evaluation of the Tier 2 Key Factors. For Tier 2 Key Factor 1, the demonstration provided an analysis of fire emissions (Q) and distance (D) of the wildfires to the monitoring site locations.[18] The Q/D value is generally calculated by dividing wildfire emissions (in tons per day) by the distance between the wildfire and the monitoring site (in kilometers [km]). Daily Q/D values were calculated by the EPA using daily wildland fire emissions input files originally created for the Community Multiscale Air Quality (CMAQ) modeling system. The resulting calculations were shared with CARB to assist in demonstration development. CMAQ input files included daily total emissions of nitrogen oxide (NO), nitrogen dioxide (NO_2),

[17] See demonstration, pp. 58-59, 75-76.
[18] See demonstration, pp. 55-58.

and reactive organic gases (ROG) at release points corresponding to wildfire locations. Q/D was calculated for each CMAQ input release point by calculating the distance between release point locations and gridded receptor locations and dividing the associated fire's daily total emissions by this distance. An aggregated daily Q/D was then calculated by summing the individual Q/D values for each release point. An "effective Q/D" value was then calculated at monitoring site receptor locations by accounting for periods where multiple days of wildfire smoke buildup impacted the monitoring site for up to three total days; the dates to include in each daily "effective Q/D" was based on meteorology and transport analyses, with the rationale further outlined in the demonstration.[19] The effective Q/D values in Table 4-1 of the demonstration are below the Tier 2 Key Factor 1 screening value of 100 tons per day/km.[20] Therefore, the event exceedances do not meet Tier 2 Key Factor 1.

For Tier 2 Key Factor 2, the demonstration included evidence that the exceedances are at or above the 99th percentile from the past five years of O_3 season data (2013-2017) or among the four highest concentrations measured at the site in 2018. In the demonstration, CARB determined an "adjusted 4th high" corresponding to the 4th highest non-event exceedance monitored in 2018, excluding the exceedances included in the demonstration. CARB stated that dates impacted by exceptional events should not count against the tally of the four highest O_3 concentrations measured in 2018 because these exceedances were caused by contributions from wildfire emissions.[21] This rationale is supported given that the purpose of the test is to show that the exceedances are high compared to non-event data. Since the excluded dates are all included in the demonstration being evaluated in this Technical Support Document (TSD), each individual date would not count towards the four highest concentrations if concurred on by the EPA. As demonstrated in Table 4-2 of the demonstration, the monitored O_3 concentration on all dates requested as exceptional events exceed the adjusted 4th high O_3 concentration at the Red Hills monitoring site in 2018.[22]Therefore, the event exceedances meet Tier 2 Key Factor 2.

Based on the analysis of the Key Factors for Tier 2, the EPA's wildfire O_3 guidance document indicates that a Tier 3 analysis is appropriate for this event. As described below, the demonstration included the required elements for a Tier 3 clear causal relationship analysis based on the EPA's wildfire O_3 guidance document. This includes evidence to support that (1) wildfire emissions were transported from the wildfire to the monitor; (2) wildfire emissions affected the monitor; and (3) wildfire emissions caused the O_3 exceedances.

<u>Evidence of transport of wildfire emissions from the wildfire to the monitor</u>
The demonstration presented evidence that emissions from the Mendocino Complex (Ranch and River), Natchez, Carr, Donnell, Ferguson, and Turkey fires in California and the Klondike and Taylor Creek fires in Southern Oregon were transported to the Red Hills monitor during this event. The evidence includes backward trajectory analysis from the monitor, as well as forward dispersion modeling from individual wildfires, satellite imagery and National Oceanic and Atmospheric Administration (NOAA) HMS satellite-derived smoke layers, and meteorological analyses.

[19] See demonstration, pp. 56-58.
[20] See demonstration, p. 58.
[21] See demonstration, pp. 58-59.
[22] See demonstration, p. 59.

CARB used the HYSPLIT model to generate 48-hour back trajectories originating from the Red Hills monitoring station at 100-, 500-, and 1000-meter (m) altitudes. Using Google Earth, the back trajectories were combined with HMS Fire and Smoke Product smoke layers and fire locations, as well as Moderate Resolution Imaging Spectroradiometer (MODIS) Aqua or Terra satellite images.[23] The satellite imagery and HMS smoke contours show areas of light to heavy smoke density at or near the Red Hills monitoring station for each exceedance day. CARB also conducted 36-hour forward dispersion modeling using HYSPLIT for each major fire.[24] The back trajectories and forward dispersion plots, as well as HMS smoke plume analyses and MODIS satellite layers, are consistent with transport to the monitor from the wildfires at the Oregon/California border and larger California wildfires dispersed throughout the northern and central portions of the State.

In Figures 3-9 and 3-19, and Appendix III, Section A, the demonstration analyzed synoptic scale meteorological features using NWS daily surface and upper atmosphere maps from August 3 through August 9, 2018.[25] This period was characterized by a strong 500 millibar (mb) high pressure over much of the southwest U.S., resulting in dry, warm conditions with generally northerly winds over California. The meteorological analysis provides additional support for Oregon and California wildfire smoke and emissions being transported to the Red Hills monitor.

Overall, the trajectory analyses and satellite imagery support the conclusion that emissions from the Mendocino Complex (Ranch and River), Natchez, Carr, Donnell, Ferguson, and Turkey fires in California and the Klondike and Taylor Creek fires in Southern Oregon were transported to the Red Hills monitor on the days requested for exclusion as exceptional events.

Evidence that the wildfire emissions affected the monitor

The demonstration provided evidence of wildfire emissions affecting the Red Hills monitor with an analysis of hourly O_3 concentrations and $PM_{2.5}$ concentrations from a Purple Air sensor co-located at the site. There are no regulatory $PM_{2.5}$ monitors available at the Red Hills site or in nearby locations, therefore the demonstration utilizes Purple Air data in the analysis.[26] A time series plot of hourly O_3 and $PM_{2.5}$ concentrations from August 1-13, 2018, shows the increases in $PM_{2.5}$ concentrations generally coincide with increases in O_3 concentrations, particularly on the O_3 exceedance days. At the start of the event, $PM_{2.5}$ and O_3 concentrations both increase sharply around 10:00 PM Pacific Standard Time (PST) on August 3, with the majority of O_3 concentrations that contributed to the August 3 exceedance occurring during the overnight hours into early on August 4.[27] Simultaneous spikes in $PM_{2.5}$ and O_3 concentrations are observed on the subsequent exceedance days of August 6, 7, and 9. The highest $PM_{2.5}$ and O_3 concentrations of this time period occurred in the early evening of August 6 (around 5:00 PM, PST). This was the day the Turkey Fire ignited around 1:00 PM PST approximately 15 miles upwind of the Red Hills monitor. Overall, O_3 concentrations were greater than 0.050 ppm for all hours where the

[23] See demonstration, pp. 30-31, 34, 37-38, 40-41, 45-46, Appendix IV-B, pp. 145-154.
[24] See demonstration, pp. 32, 35-36, 39, 42, 47-48, Appendix IV-A, pp. 110-144.
[25] See demonstration, pp. 29, 43 Appendix III-A, pp. 100-106.
[26] See demonstration, p. 11-13, 48-49.
[27] EPA's data handling regulations for the 2015 O3 NAAQS, found at 40 CFR 50 Appendix U, section 3(c), states: "The daily maximum 8-hour average O_3 concentration for a given day is the highest of the 17 consecutive 8-hour averages beginning with the 8-hour period from 7:00 a.m. to 3:00 p.m. and ending with the 8-hour period from 11:00 p.m. to 7:00 a.m. the following day (*i.e.,* the 8-hour averages for 7:00 a.m. to 11:00 p.m.)." It is therefore possible to have a daily 8-hour maximum value made up of hours primarily measured in the early hours of the following day, as happened at the Sonora-Barretta monitor on August 3, 2018.

$PM_{2.5}$ sensor values were greater than 20 $\mu g/m^3$, regardless of time of day. The consistent relationship between high $PM_{2.5}$ and elevated O_3 values is evidence that the Red Hills monitoring site was influenced by wildfire emissions during this event.

The demonstration provided additional evidence of O_3 concentrations at the Red Hills monitoring station being affected by wildfire emissions. Figures 4-17 through 4-23 assess diurnal patterns in O_3 concentrations by comparing hourly O_3 concentrations for August 3-9, 2018 with the 5th, 50th, and 95th percentile O_3 concentrations for each hour based on 2013-2017 data.[28] The 5th and 50th percentile hourly profiles show a similar pattern to one another, with the lowest O_3 concentrations (ranging from approximately 0.023 to 0.040 ppm) observed overnight from 7:00 PM PST through 6:00 AM PST, then increasing to peak levels from about 0.035 to 0.050 ppm midday from 12:00 PM PST to 3:00 PM PST, and finally decreasing through the afternoon, evening, and nighttime hours. The 95th percentile profile is fairly flat and lacks the midday peak feature, hovering slightly above and below the 0.065 ppm level all hours of the day.

On August 3, prior to the start of wildfire emissions affecting the Red Hills monitoring station, the diurnal profile was fairly similar to the percentile profiles. Then, in the late afternoon, O_3 begins climbing to a peak above the 95th percentile at 11:00 PM PST. This late-night increase in O_3 is atypical based on the percentile profiles, and highly consistent with transport rather than local photochemical production. On August 4, O_3 remains above the 95th percentile through the night and early morning hours and much of the day, which again is a clearly atypical pattern for this monitor. After 8:00 PM PST on August 4, O_3 drops and follows a more typical pattern with values around the 50th percentile through August 5 while smoke clears the area. On August 6, O_3 begins climbing in the late afternoon to a peak of 0.080 ppm at 5:00 PM PST and remains above the 95th percentile through 9:00 PM PST. O_3 concentrations again increase above the 95th percentile the afternoon of August 7 and remain above or near the 95th percentile through the night. O_3 levels continue to hover around the 95th percentile levels to a near-exceedance of 0.068 ppm on August 8. O_3 remained near the 95th percentile level through the early morning of August 9, then climbed above the 95th percentile around 5:00 AM PST and remained stable for most of the day. Most exceedance days exhibited atypical patterns of late afternoon to evening peaks, some days remaining above the 95th percentile through the nighttime. As these increases occurred while light intensity was decreasing and wind speeds were generally increasing, factors which normally act to reduce O_3 concentrations, the late afternoon to nighttime peaks suggest transport of O_3 and/or high concentrations of O_3 precursors into the area at those times. While August 9 did not peak in the evening, the hourly values above the 95th percentile from the morning into early afternoon are also atypical.

The demonstration presents other evidence that the wildfire emissions reached the ground and affected the Red Hill monitoring station. The demonstration included NAAPS Global Aerosol Model outputs and NOAA Smoke Text Products for August 3- 9, 2018.[29] The NAAPS Global Aerosol Model results showing total optical depth for each day support that smoke extended over California and the Red Hills region each day during this time-period. Additionally, the smoke surface concentrations from these products show the varied surface smoke levels on each day

[28] See demonstration, pp. 77-81.
[29] See demonstration, pp. 82-86, Appendix V, pp. 155-166.

and indicate smoke at the surface in the Red Hills monitor area.[30] The NOAA Smoke Text Products describe the wildfire smoke from Southwest Oregon and Northern California to the San Joaquin Valley during the time of the requested exceptional event days using descriptors such as dense, heavy, and thick. Of note, the product covering the event period of August 3 through August 4, 0547 Universal Coordinated Time (UTC) (August 3 at 10:47 PM PST), states "very dense smoke was located closer to the ongoing wildfires over California." [31]

The demonstration provided air quality alerts, health advisories, and media reports for San Luis Obispo County.[32] The first advisory issued around this time-period was on July 30, 2018. It informed the public of the ongoing impact of wildfire smoke on much of the District, warning of the potential for elevated $PM_{2.5}$ and O_3 concentrations, and that "until the fires are put out, smoke will likely be intermittently present in our (San Luis Obispo) region. "An updated Alert was issued on Monday August 6. Additional alerts and advisories were sent out from August 6 through August 10, including updates pertaining to the nearby Turkey Fire which was ignited on August 6.[33]

Overall, the O_3 and $PM_{2.5}$ concentration analysis, air quality/health advisories, NOAA Smoke Text Products, and NAAPS Global Aerosol Model outputs provide additional weight-of-evidence support that smoke was observed at ground level and affected air quality at the Red Hills monitor and nearby areas.

Additional evidence that the wildfire emissions caused the O_3 exceedance

The demonstration included additional evidence to support that the wildfire emissions specifically affected O_3 concentrations at the exceeding Red Hills monitoring site and caused the O_3 exceedances. The demonstration provided an analysis of hourly $PM_{2.5}$ concentrations at $PM_{2.5}$ monitors in areas intersected by the back trajectories. The demonstration presents figures with the back trajectories and HMS smoke contours for each day of the event plotted with the $PM_{2.5}$ monitors, as well as graphs of hourly $PM_{2.5}$ concentrations for the monitors located in the back trajectory pathways. Increases in measured $PM_{2.5}$ concentrations generally coincide with the times the back trajectories were at or near surface levels, particularly at the $PM_{2.5}$ monitors located in the San Joaquin Valley. The demonstration concludes that the $PM_{2.5}$ trajectory analysis is consistent with meteorological transport patterns discussed in the Narrative Conceptual Model and provides evidence supporting transport of smoke to the Red Hills monitoring site. [34]

Overall, the $PM_{2.5}$ back trajectory analysis, coupled with the coincident increases in O_3 and $PM_{2.5}$ concentrations at atypical times that are inconsistent with photochemical activity, and other weight-of-evidence described above clearly show that wildfire emissions from the various fires described in the demonstration caused the O_3 exceedances observed during August 3-9, 2018.

Conclusion

The analyses included in the demonstration, specifically the comparison with historical O_3 8-hour maximum concentrations, Tier 2 Key Factors including Q/D analyses, HYSPLIT analyses,

[30] See demonstration, p. 86, Appendix V, pp. 155-162.
[31] See demonstration, pp. 84-85.
[32] See demonstration, pp. 51-52, 95-99, Appendix VI, pp.169-183.
[33] See demonstration, pp. 51-52.
[34] See demonstration, pp. 60-75.

HMS contours, satellite imagery, meteorology analysis, media reports of smoke and visibility analysis, evidence of impact to hourly data of O_3 and $PM_{2.5}$ concentrations, NOAA Text Products, NAAPS Global Aerosol Model outputs, and NWS Area Forecast Discussions, sufficiently demonstrate a clear causal relationship between the emissions generated by multiple wildfires in California and Southern Oregon and the exceedances measured at the Red Hills monitoring site.

Table 4: Documentation of the Clear Causal Relationship criterion

Exceedance Date	Demonstration Citation	Quality of Evidence	Criterion Met?
August 3-4, 2018 August 6-7, 2018 August 9, 2018	"Background": pp. 11-13 "Narrative Conceptual Model": pp. 30-32, 34-43, 45-52 "Clear Causal Relationship": pp. 55-86, 95-99 Appendix III-A: pp. 100-106 Appendix IV, pp. 110-144, 145-154 Appendix V, pp. 155-166. Appendix VI, pp.169-183.	Sufficient	Yes

Not Reasonably Controllable or Preventable

The Exceptional Events Rule presumes that wildfire events on wildland are not reasonably controllable or preventable [40 CFR §50.14(b)(4)]. The demonstration provided evidence that the wildfire event meets definition of wildfire [40 CFR §50.1(n)]. Specifically, maps and descriptions of the wildfires, along with figures showing wildfire boundaries overlaid upon land ownership and wildland-urban interface layers to demonstrate that the fires occurred on wildland or in the urban/wildland interface.[35] The demonstration described that CARB is not aware of any evidence clearly demonstrating that prevention or control efforts beyond those actually made would have been reasonable.[36] Therefore, the documentation provided sufficiently demonstrates that the event was not reasonably controllable and not reasonably preventable.

Table 5: Documentation of the Not Reasonably Controllable or Preventable criterion

Exceedance Date	Demonstration Citation	Quality of Evidence	Criterion Met?
August 3-4, 2018 August 6-7, 2018 August 9, 2018	"Narrative Conceptual Model": pp. 16-28 "Not Reasonably Controllable and/or Not Reasonably Preventable": p. 87	Sufficient	Yes

Natural Event

The definition of "wildfire" at 40 CFR §50.1(n) states, "A wildfire that predominantly occurs on wildland is a natural event." As previously described, the demonstration included documentation that the event meets the definition of a wildfire and occurred predominantly on wildland and has therefore shown that the event was a natural event.

[35] See demonstration, pp. 16-28.
[36] See demonstration, p. 87.

Table 6: Documentation of the Natural Event criterion

Exceedance Date	Demonstration Citation	Quality of Evidence	Criterion Met?
August 3-4, 2018 August 6-7, 2018 August 9, 2018	"Narrative Conceptual Model": pp. 16-28 "Natural Event/Human Activity Unlikely to Recur": p. 87	Sufficient	Yes

Schedule and Procedural Requirements

In addition to technical demonstration requirements, 40 CFR §50.14(c) and 40 CFR §51.930 specify schedule and procedural requirements an air agency must follow to request data exclusion. Table 7 outlines the EPA's evaluation of these requirements.

Table 7: Schedules and Procedural Criteria

	Reference	Demonstration Citation	Criterion Met?
Did the agency provide prompt public notification of the event?	40 CFR §50.14 (c)(1)(i)	"Narrative Conceptual Model," pp. 51-52 Appendix II: pp. 95-99	Yes
Did the agency submit an Initial Notification of Potential Exceptional Event and flag the affected data in the EPA's Air Quality System (AQS)?	40 CFR §50.14 (c)(2)(i)	Appendix I: pp. 92-94	Yes
Did the initial notification and demonstration submittals meet the deadlines for data influenced by exceptional events for use in initial area designations, if applicable? Or the deadlines established by the EPA during the Initial Notification of Potential Exceptional Events process, if applicable?	40 CFR §50.14 Table 2 40 CFR §50.14 (c)(2)(i)(B)	Appendix I: pp. 92-94 Letter from Gwen Yoshimura, EPA R9, to Sylvia Vanderspek, CARB, dated April 21, 2021	Yes
Was the public comment process followed and documented? • Did the agency document that the comment period was open for a minimum of 30 days? • Did the agency submit to the EPA any public comments received? • Did the state address comments disputing or contradicting factual evidence provided in the demonstration?	40 CFR §50.14 (c)(3)(v)	"Public Notification": p. 87 Letter from Michael Benjamin, CARB, to Elizabeth Adams, EPA R9, dated September 3, 2021	Yes
Has the agency met requirements regarding submission of a mitigation plan, if applicable?	40 CFR §51.930 (b)	N/A	N/A

Conclusion

The EPA has reviewed the documentation provided by CARB to support claims that smoke from wildfires in California and Oregon, namely the Mendocino Complex (Ranch and River fires), Natchez, Carr, Donnell, Ferguson, and Turkey Fires, as well as the Klondike and Taylor Creek Fires in Southern Oregon, caused exceedances of the 2015 8-hour O_3 NAAQS at the Red Hills monitoring site on August 3-4, August 6-7, and August 9, 2018. The EPA has determined that the flagged exceedances at this monitoring site on these days satisfy the exceptional event criteria: the event was a natural event, which affected air quality in such a way that there exists a clear causal relationship between the event and the monitored exceedances and was not reasonably controllable or preventable. The EPA has also determined that CARB has satisfied the schedule and procedural requirements for data exclusion.

ENCLOSURE: TECHNICAL SUPPORT DOCUMENT FOR EPA CONCURRENCE ON O_3 EXCEEDANCES MEASURED IN THE EASTERN PART OF SAN LUIS OBISPO COUNTY, CALIFORNIA ON AUGUST 20-21, 2020 AS AN EXCEPTIONAL EVENT

On December 8, 2021, the California Air Resources Board (CARB) submitted an exceptional event demonstration for exceedances of the 2015 8-hour ozone (O_3) National Ambient Air Quality Standards (NAAQS) of 0.070 parts per million (ppm) that occurred at the Red Hills monitoring site on August 20-21, 2020.[1] The demonstration submitted by CARB stated that the exceedances measured on August 20-21, 2020 were caused by numerous wildfires burning throughout California including the CZU Lightening Complex, SCU Lightening Complex, River, Carmel, Dolan, and Hills fires among others.[2] Under the Exceptional Events Rule, air agencies can request the exclusion of event-influenced data, and the EPA can agree to exclude these data, from the data set used for certain regulatory decisions. The remainder of this document summarizes the Exceptional Events Rule requirements, the event and the EPA's review process.

EXCEPTIONAL EVENTS RULE REQUIREMENTS

The EPA promulgated the Exceptional Events Rule in 2007, pursuant to the 2005 amendment of Clean Air Act (CAA) Section 319. In 2016, the EPA finalized revisions to the Exceptional Events Rule. The 2007 Exceptional Events Rule and 2016 Exceptional Events Rule revisions added sections 40 CFR §50.1(j)-(r); §50.14; and §51.930 to title 40 of the Code of Federal Regulations (CFR). These sections contain definitions, criteria for EPA approval, procedural requirements, and requirements for air agency demonstrations. The EPA reviews the information and analyses in the air agency's demonstration package using a weight of evidence approach and decides to concur or not concur. The demonstration must satisfy all of the Exceptional Events Rule criteria for the EPA to concur with excluding the air quality data from regulatory decisions.

Under 40 CFR §50.14(c)(3)(iv), the air agency demonstration to justify exclusion of data must include:

A. "A narrative conceptual model that describes the event(s) causing the exceedance or violation and a discussion of how emissions from the event(s) led to the exceedance or violation at the affected monitor(s);"

B. "A demonstration that the event affected air quality in such a way that there exists a clear causal relationship between the specific event and the monitored exceedance or violation;"

C. "Analyses comparing the claimed event-influenced concentration(s) to concentrations at the same monitoring site at other times" to support requirement (B) above;

[1] "Exceptional Events Demonstration for Ozone Exceedances Southern California 2020 Wildfire Events," December 8, 2021 ("demonstration"). The demonstration also includes exceptional events analyses for other California nonattainment areas for the 2008 and 2015 NAAQS. The EPA's evaluation of the information presented in the demonstration is reflected in five separate technical support documents.

[2] See demonstration, pp. 23-26.

D. "A demonstration that the event was both not reasonably controllable and not reasonably preventable;" and

E. "A demonstration that the event was a human activity that is unlikely to recur at a particular location or was a natural event."[3]

In addition, the air agency must meet several procedural requirements, including:

1. submission of an Initial Notification of Potential Exceptional Event and flagging of the affected data in the EPA's Air Quality System (AQS) as described in 40 CFR §50.14(c)(2)(i),

2. completion and documentation of the public comment process described in 40 CFR §50.14(c)(3)(v), and

3. implementation of any relevant mitigation requirements as described in 40 CFR §51.930.

For data influenced by exceptional events to be excluded from use in initial area designations, air agencies must also meet the initial notification and demonstration submission deadlines specified in Table 2 to 40 CFR §50.14. We include below a summary of the Exceptional Events Rule criteria, including those identified in 40 CFR §50.14(c)(3)(iv).

Regulatory Significance

The 2016 Exceptional Events Rule includes regulatory language that applies the provisions of CAA section 319 to a specific set of regulatory actions. As identified in 40 CFR §50.14(a)(1)(i), these regulatory actions include initial area designations and redesignations; area classifications; attainment determinations (including clean data determinations); attainment date extensions; findings of State Implementation Plan (SIP) inadequacy leading to a SIP call; and other actions on a case-by-case basis as determined by the Administrator. Air agencies and the EPA should discuss the regulatory significance of an exceptional events demonstration during the Initial Notification of Potential Exceptional Event prior to the air agency submitting a demonstration for the EPA's review.

Narrative Conceptual Model

The 2016 Exceptional Events Rule directs air agencies to submit, as part of the demonstration, a narrative conceptual model of the event that describes and summarizes the event in question and provides context for analyzing the required statutory and regulatory technical criteria. Air agencies may support the narrative conceptual model with summary tables or maps. For wildfire O_3 events, the EPA recommends that the narrative conceptual model also discuss the interaction of emissions, meteorology, and chemistry of event and non-event O_3 formation in the area, and,

[3] A natural event is further described in 40 CFR 50.1(k) as "an event and its resulting emissions, which may recur at the same location, in which human activity plays little or no direct causal role. For purposes of the definition of a natural event, anthropogenic sources that are reasonably controlled shall be considered to not play a direct role in causing emissions."

under 40 CFR §50.14(a)(1)(i), must describe the regulatory significance of the proposed data exclusion.

Clear Causal Relationship and Supporting Analyses

The EPA considers a variety of evidence when evaluating whether there is a clear causal relationship between a specific event and the monitored exceedance or violation. For wildfire O_3 events, air agencies should compare the O_3 data requested for exclusion with seasonal and annual historical concentrations at the air quality monitor to establish a clear causal relationship between the event and monitored data. In addition to providing this information on the historical context for the event-influenced data, air agencies should further support the clear causal relationship criterion by demonstrating that the wildfire's emissions were transported to the monitor, that the emissions from the wildfire influenced the monitored concentrations, and, in some cases, air agencies may need to provide evidence of the contribution of the wildfire's emissions to the monitored O_3 exceedance or violation.

For wildfire O_3 events, the EPA has published a guidance document that provides three different tiers of analyses that apply to the "clear causal relationship" criterion within an air agency's exceptional events demonstration.[4] This tiered approach recognizes that some wildfire events may be more clear and/or extreme and, therefore, require relatively less evidence to satisfy the rule requirements. If a wildfire/O_3 event satisfies the key factors for either Tier 1 or Tier 2 clear causal analyses, then those analyses are the only analyses required to support the clear causal relationship criterion within an air agency's demonstration for that particular event. Other wildfire/O_3 events will be considered based on Tier 3 analyses.

- Tier 1: Wildfires that clearly influence monitored O_3 exceedances or violations when they occur in an area that typically experiences lower O_3 concentrations.
    - *Key Factor*: seasonality and/or distinctive level of the monitored O_3 concentration. The event-related exceedance occurs during a time of year that typically has no exceedances, or is clearly distinguishable (*e.g.*, 5-10 parts per billion (ppb) higher) from non-event exceedances.
    - In these situations, O_3 impacts should be accompanied by clear evidence that the wildfire's emissions were transported to the location of the monitor.

- Tier 2: The wildfire event's O_3 influences are higher than non-event related concentrations, and fire emissions compared to the fire's distance from the affected monitor indicate a clear causal relationship.
    - *Key Factor 1*: fire emissions and distance of fire(s) to affected monitoring site location(s). Calculated fire emissions of nitrogen oxides NO_x and reactive-volatile organic compounds (VOC) in tons per day (Q) divided by the distance from the fire to the monitoring site (D) should be equal to or greater than 100 tons per day/kilometers ($Q/D \geq 100$ tpd/km). The guidance document provides additional information on the calculation of Q/D.

[4] "Guidance on the Preparation of Exceptional Events Demonstrations for Wildfire Events that May Influence Ozone Concentrations" (September 2016) ("wildfire O_3 guidance document").

- *Key Factor 2*: comparison of the event-related O_3 concentration with non-event related high O_3 concentrations. The exceedance due to the exceptional event:
  - is in the 99th or higher percentile of the 5-year distribution of O_3monitoring data, OR
  - is one of the four highest O_3concentrations within 1 year (among those concentrations that have not already been excluded under the Exceptional Events Rule, if any).
- In addition to the analysis required for Tier 1, the air agency should supply additional evidence to support the weight of evidence that emissions from the wildfire affected the monitored O_3 concentration.

- Tier 3: The wildfire does not fall into the specific scenarios (i.e. does not meet the key factors) that qualify for Tier 1 or Tier 2, but the clear causal relationship criterion can still be satisfied by a weight of evidence showing.
  - In addition to the analyses required for Tier 1 and Tier 2, an air agency may further support the clear causal relationship with additional evidence that the fire emissions caused the O_3 exceedance.

Not Reasonably Controllable or Preventable

The Exceptional Events Rule requires that air agencies establish that the event be both not reasonably controllable and not reasonably preventable at the time the event occurred. This requirement applies to both natural events and events caused by human activities; however, it is presumed that wildfires on wildland will satisfy both factors of the "not reasonably controllable or preventable" element unless evidence in the record clearly demonstrates otherwise.[5]

Natural Event

According to the CAA and the Exceptional Events Rule, an exceptional event must be "an event caused by human activity that is unlikely to recur at a particular location *or* a natural event" (emphasis added). The 2016 Exceptional Events Rule includes in the definition of wildfire that "[a] wildfire that predominantly occurs on wildland is a natural event." Once an agency provides evidence that a wildfire on wildland occurred and demonstrates that there is a clear causal relationship between the measurement under consideration and the event, the EPA expects minimal documentation to satisfy the "human activity that is unlikely to recur at a particular location or a natural event" element. The EPA will address wildfires on other lands on a case-by-case basis.

EPA REVIEW OF EXCEPTIONAL EVENTS DEMONSTRATION

On March 16, 2021, CARB submitted an Initial Notification of a potential Exceptional Event for numerous exceedances of the 2015 8-hour O_3 NAAQS that occurred at the Red Hills monitoring

[5] A wildfire is defined in 40 CFR 50.1(n) as "any fire started by an unplanned ignition caused by lightning; volcanoes; other acts of nature; unauthorized activity; or accidental, human-caused actions, or a prescribed fire that has developed into a wildfire. A wildfire that predominantly occurs on wildland is a natural event." Wildland is defined in 40 CFR 50.1(o) as "an area in which human activity and development are essentially non-existent, except for roads, railroads, power lines, and similar transportation facilities. Structures, if any, are widely scattered."

site within Eastern San Luis Obispo County, California (CA) between August 18, 2020, and November 1, 2020.[6] On December 8, 2021, CARB submitted an exceptional event demonstration for two exceedances of the 2015 8-hour O_3 NAAQS that occurred at the Red Hills monitoring site within Eastern San Luis Obispo County, CA on August 20-21, 2020.[7]

Regulatory Significance

The EPA determined that data exclusion of certain exceedances referenced in the Initial Notification may have a regulatory significance for a determination of attainment by the attainment date for the San Luis Obispo (Eastern part), CA Marginal nonattainment area for the 2015 O_3 NAAQS and worked with CARB to identify the relevant exceedances and monitoring sites affected.[8] Table 1 summarizes the exceedances measured at the Red Hills monitoring site on August 20-21, 2020 that CARB included in the demonstration.

Table 1: 2015 8-hour O_3 NAAQS Exceedance Summary

Exceedance Date	Monitoring Site Name	AQS ID	2015 8-hour Avg. (ppm)
August 20, 2020	Red Hills	06-079-8005	0.076
August 21, 2020	Red Hills	06-079-8005	0.106

Narrative Conceptual Model

The demonstration submitted by CARB provided a narrative conceptual model in the "Overview/Introduction," "Background," and "Narrative Conceptual Model" sections of the demonstration to describe how emissions from the numerous California wildfires active at the time of the exceedances caused the O_3 exceedances at the Red Hills monitoring site. The demonstration addressed the regulatory significance of the exceptional event in Section I, "Overview/Introduction," by stating that the exclusion of wildfire events in 2018 and 2020 would affect a determination of attainment for the San Luis Obispo (Eastern part), CA Marginal nonattainment area for the 2015 O_3 NAAQS.[9] The "Overview/Introduction" and "Background" chapters provided information supporting the narrative conceptual model including characteristics of the nonattainment area, such as geography, topography, meteorology, the ambient O_3 monitoring network, typical non-event O_3 formation conditions and patterns, seasonal O_3 variations, and emissions of O_3 precursors.[10]

The narrative conceptual model described characteristics of the event. This included a summary of the occurrences of wildfires in California and specific descriptions of individual wildfires, notably the CZU Lightning Complex, SCU Lightning Complex, River, Carmel, Dolan, and Hills fires, that generated smoke contributing to O_3 exceedances at the Red Hills monitoring site from August 20-21, 2020.[11] The demonstration provided tables for the actively burning fires during the time of the exceedances which include the fire name, source, start date, containment date,

[6] See email from Sylvia Vanderspek, CARB, to Gwen Yoshimura, EPA Region 9, dated March 16, 2021.
[7] See letter from Michael Benjamin, CARB, to Matthew Lakin, EPA Region 9, dated December 8, 2021.
[8] See letter from Elizabeth Adams, EPA Region 9, to Sylvia Vanderspek, CARB, dated April 21, 2021.
[9] See demonstration, pp. 2, 4-6.
[10] See demonstration, pp. 8-9, 13-18, 21-22.
[11] See demonstration, pp. 23-26.

location, and total acreage burned along with maps of the fire perimeters.[12] The narrative conceptual model also included figures displaying meteorological conditions on the dates of the fires and Hybrid Single Particle Lagrangian Integrated Trajectory (HYSPLIT) modeling results. The HYSPLIT trajectory modeling results were presented with Terra Moderate Resolution Imaging Spectroradiometer (MODIS) satellite imagery, National Oceanic and Atmospheric Administration (NOAA) Hazard and Mapping System (HMS) satellite-derived smoke layers, and meteorological analysis to provide visual evidence that wildfire emissions were transported to the Red Hills monitoring site in the South Central Coast Air Basin on the exceptional event dates requested for exclusion.[13] Along with these graphics, the narrative conceptual model included daily weather maps showing nationwide meteorological movement patterns, temperature, pressure, and precipitation on August 18, 2020, as well as narrative descriptions of how weather patterns contributed to the ignition and growth of wildfires and how these meteorological conditions led to the transport and mixing of air and smoke in the areas of the wildfires southeast to San Luis Obispo County on August 20-21, 2020.[14]

The narrative conceptual model included charts showing event related concentrations of 1-hour O_3 and particulate matter less than or equal to 2.5 microns in aerodynamic diameter ($PM_{2.5}$) from August 15-25, 2020, from a nonregulatory Purple Air sensor at the Red Hills monitoring site and from a regulatory $PM_{2.5}$ monitor at the Atascadero – Lift Station #5 monitoring site, which is approximately 35 miles west of Red Hills and about 871 feet lower in elevation. The demonstration stated that the timing of elevated $PM_{2.5}$ concentrations at these sites show strong connections with O_3 increases and prolonged elevated concentrations, supporting the presence of wildfire smoke at and nearby the Red Hills monitoring site.[15] The demonstration also included a chart of 8-hour O_3 design values and annual 4th high 8-hour average O_3 concentrations at the Red Hills monitoring site from 2009 to 2020.[16]

The narrative conceptual model also included daily meteorological data such as temperatures and wind speeds along with 1-hour and 8-hour O_3 concentrations from the Red Hills monitoring site. Table III-23 shows the daily values from August 15-24, 2020. Daily maximum temperatures measured on August 20-21, 2020, were lower (90.1degrees Fahrenheit (°F) and 90.7°F respectively) than the high 90s measured on the days prior (August 16-19, 2020). Daily maximum wind speeds varied between 11-26 miles per hour (mph) throughout this time period, with higher wind speeds on August 22-24, 2020. At the same time, the days prior and following the event which experienced higher temperatures and similar wind speeds measured lower maximum 8-hour O_3 concentrations compared to the August 20-21, 2020 event days. The demonstration concluded that weather patterns observed at the Red Hills monitoring site on the exceptional event days were not generally more favorable for O_3 formation, and that O_3 directly related to wildfire smoke influenced the exceedances rather than unusual weather.[17]

The narrative conceptual model included a description of air quality advisories issued by the San Luis Obispo County Air Pollution Control District (APCD), a copy of an alert issued jointly by

[12] See demonstration, pp. 25-66
[13] See demonstration, pp. 69-77, Appendix D, pp. 188-233, 239-240.
[14] See demonstration, pp. 70-76.
[15] See demonstration, pp. 84-87.
[16] See demonstration, pp. 88-89.
[17] See demonstration, pp. 93-97.

the San Luis Obispo County APCD and San Luis Obispo Public Health Department on August 21, 2020, and examples of social media coverage of the 2020 wildfires throughout California.[18]

Overall, the demonstration contained the elements required for inclusion in the conceptual model portion of the exceptional events demonstration.

Table 2: Documentation of the Narrative Conceptual Model

Exceedance Date	Demonstration Citation	Quality of Evidence	Criterion Met?
August 20-21, 2020	"Overview/Introduction": pp. 2-6 "Background": pp. 8-22 "Narrative Conceptual Model": pp. 23-100 Appendix B: pp.154-155 Appendix C: pp.159-160 Appendix D: pp. 188-233, 239-240. Appendix F: pp. 260-268	Sufficient	Yes

Clear Causal Relationship

The demonstration included several analyses to support a clear causal relationship between the wildfire event and the monitored exceedances. These analyses were presented in Section IV of the demonstration titled "Clear Causal Relationship."

Comparison with historical concentrations

The demonstration included a comparison with historical concentrations, as required by 40 CFR §50.14(c)(3)(iv)(C). The demonstration compared O_3 concentrations at the Red Hills monitoring site on the 2020 wildfire exceptional event days to historical non-event O_3 concentrations from 2015-2020. This included a graph of daily maximum 8-hour average concentrations over the six-year period by day of the year, along with the level of the NAAQS and the 99th percentile value at the site. Figure IV-1 of the demonstration shows that the exceedance days occurred during the time of year when O_3 concentrations tend to be higher at the Red Hills monitoring site. The demonstration also noted that the August 21, 2020 exceedance of 0.106 ppm was the highest concentration measured in the 2015-2020 period, measuring 20 ppb above the second highest concentration measured in this period.[19]

Tier 1: Key Factor

To meet the key factor for a Tier 1 analysis, exceedances should be clearly higher than other non-event related exceedances or occur during a time of year that typically experiences no exceedances. While the exceedances identified in this demonstration occurred during the time of year when O_3 concentrations tend to be higher at the Red Hills monitoring site, the August 21, 2020 exceedance of 0.106 ppm was the highest concentration measured in the 2015-2020 period. As it was 20 ppb higher than the second highest concentration measured over this six year period, the August 21, 2020 exceedance qualifies for a Tier I analysis. The August 20, 2020 exceedance did not exceed non-event exceedance concentrations by at least 5 ppb. [20] Therefore,

[18] See demonstration, pp. 97-100, Appendix B.1, pp.154-155, Appendix F.1, pp.260-268
[19] See demonstration, pp. 102-104.
[20] See demonstration, pp.103-104.

this exceedance did not meet the Tier 1 Key Factor, and additional evidence beyond a Tier 1 analysis is needed to support the clear causal relationship.

Tier 2: Key Factors

The demonstration included an evaluation of the Tier 2 Key Factors. For Tier 2 Key Factor 1, the demonstration provided an analysis of fire emissions (Q) and distance (D) of the wildfires to the monitoring site locations. The Q/D value is generally calculated by dividing wildfire emissions (in tpd) by the distance between the wildfire and the monitoring site (in kilometers [km]). Daily Q/D values were calculated by the EPA using daily wildland fire emissions input files originally created for the Community Multiscale Air Quality (CMAQ) modeling system. The results were shared with CARB to assist in demonstration development. CMAQ input files included associated fire's daily emissions of nitrogen oxide (NO), nitrogen dioxide (NO_2), and reactive organic gases (ROG) at release points corresponding to wildfire locations. Q/D was calculated for each CMAQ input release point by calculating the distance between release point locations and gridded receptor locations and dividing the total emissions by this distance. An aggregated daily Q/D was then calculated by summing the individual Q/D values for each release point. An "effective Q/D" value was calculated at monitoring site receptor locations accounting for periods where multiple days of wildfire smoke buildup impacts the monitoring site for up to three total days; the dates to include in each daily "effective Q/D" were based on meteorology and transport analyses, with rationale outlined in the demonstration.[21] The distance-weighted sums for August 20-21, 2020 were 118 and 104 tpd of NO_x and VOC per km respectively, which are above the Tier 2 Key Factor 1 screening value of 100 tons per day of NO_x and VOC per km.[22] Therefore, the event exceedances meet Tier 2 Key Factor 1.

For Tier 2 Key Factor 2, the demonstration included evidence that the exceedances are at or above the 99th percentile from the past five years of O_3 season data (2015-2019) or among the four highest concentrations measured at the site in 2020. In the demonstration, CARB determined an "adjusted 4th high" corresponding to the 4th highest non-event exceedance monitored in 2020, excluding the exceedances for which CARB submitted an exceptional events demonstration.[23] CARB stated that dates impacted by exceptional events should not count against the tally of the four highest O_3 concentrations measured in 2020 because these exceedances were caused by contributions from wildfire emissions.[24] This rationale is supported given that the purpose of the test is to show that the exceedances are high compared to non-event data. Since the excluded dates are all included in the demonstration being evaluated for the San Luis Obispo (Eastern part), CA Marginal nonattainment area, each individual date would not count towards the four highest concentrations if concurred on by the EPA.[25] As shown in Table IV-3 of the demonstration, the O_3 concentration measured at the Red Hills monitoring site on August 20, 2020 exceeds the adjusted 4th high O_3 concentration at this monitoring site in 2020.[26] Therefore, this event exceedance meets Tier 2 Key Factor 2.

[21] See demonstration, pp. 106-107.
[22] See demonstration, p. 108.
[23] See demonstration, pp. 111-112.
[24] See demonstration, p. 111.
[25] This demonstration also includes analyses for exceptional event dates that occurred at the Red Hills monitoring site on September 30 – October 2, 2020. These exceptional event dates are evaluated by the EPA in a separate TSD.
[26] See demonstration, pp. 111-112.

Based on the analysis of the Key Factors for Tier 2, the EPA's wildfire O_3 guidance document indicates that a Tier 2 analysis is appropriate for the August 20, 2020 event at the Red Hills monitoring site. While August 21, 2020 qualifies for a Tier 1 analysis, additional evidence of a clear causal relationship for the August 21, 2020 event at the Red Hills monitoring site is also provided in the demonstration, as this additional evidence supports the clear causal relationship for the August 20, 2020 event. As described below, the demonstration included the required elements for a clear causal relationship analysis based on the EPA's wildfire O_3 guidance document. This includes evidence to support that (1) wildfire emissions were transported from the wildfire to the monitor; and (2) wildfire emissions affected the monitor.

Evidence of transport of wildfire emissions from the wildfire to the monitor

The demonstration presented analyses in the "Narrative Conceptual Model" and Appendix D using backward trajectory and forward trajectory modeling.[27] In Figure III-27, HYSPLIT back trajectories originating at the monitor location at three elevations (1000 meters (m), 500m, and 100m) show the likely path of air parcels 36 hours prior to the hour of maximum concentrations within the exceeding 8-hour period on August 21, 2020, overlaid on NOAA HMS Fire and Smoke Product imagery.[28] Additional HYSPLIT back trajectories from the Red Hills monitor on August 20-21, 2020 are included in Appendix D-2 of the demonstration.[29] HYSPLIT forward trajectories showing the most likely center path of air parcels for 36 hours beginning at the wildfire location on August 20, 2020 were overlaid on satellite imagery to provide a visual analysis of whether smoke emitted from the fires may have impacted the Red Hills monitoring site (Figure III-26). Additional HYSPLIT forward trajectories from the CZU Lightening Complex, SCU Lightening Complex, River, Carmel, Dolan, and Hills fires on August 20-21, 2020 are included in Appendix D-1 of the demonstration.[30] The forward trajectory pathways from the CZU Lightning Complex, SCU Lightning Complex, River, Carmel, Dolan, and Hills fires generally approach eastern San Luis Obispo County, where the Red Hills monitor is located, and the backward trajectory pathways from August 20 and 21, 2020 pass through areas of heavy smoke and occasionally near fire locations. Overall, the backward and forward trajectory analyses support that wildfire emissions were transported to the Red Hills monitoring site on August 20-21, 2020.

Evidence that the wildfire emissions affected the monitor

The demonstration provided analyses in the "Narrative Conceptual Model" and "Clear Causal Relationship" chapters as evidence that wildfire emissions affected the Red Hills monitor on August 20- 21, 2020. In particular, Figures III-32 and III-33 demonstrated spikes in O_3 and $PM_{2.5}$ concentrations observed at the Red Hills monitor and nearby monitors between August 18 and 22, 2020.[31] The demonstration concluded that the consistent relationship between high $PM_{2.5}$ concentrations and elevated O_3 supports a strong wildfire smoke influence at the monitor. The demonstration also included an analysis of diurnal O_3 profiles at the Red Hills monitor as evidence that wildfire emissions affected the monitor. Figures IV-3 and IV-4 compared the diurnal pattern of O_3 concentrations observed at Red Hills on August 20 and 21, 2020, to hourly

[27] See demonstration, pp. 69-70, 76-77.
[28] See demonstration, pp. 76-77.
[29] See demonstration, Appendix D, pp. 239-240.
[30] See demonstration, Appendix D, pp.193-229.
[31] See demonstration, pp. 85-87.

diurnal O_3 percentiles from 2015-2019.[32] The figures demonstrated that O_3 concentrations began to stray from typical O_3 diurnal patterns on the afternoon of August 20, 2020, as O_3 concentrations spiked to abnormally high concentrations and were sustained near or above the 95th percentile of typical O_3 concentrations throughout the remainder of August 20 through all of August 21, 2020. On August 21, 2020, peak O_3 concentrations were above the 95th percentile by about 0.060 ppm. The typical diurnal profiles from 2015-2019 become elevated during the time of day when typical photochemical production would be expected to be the highest; peaks in O_3 concentrations on August 20-21, 2020 occurred later in the day, supporting atypical O_3 formation and/or sources.

The demonstration also included daily $PM_{2.5}$ concentrations and analyses of $PM_{2.5}$ diurnal profiles at nearby monitoring sites as evidence that wildfire emissions affected the Red Hills monitor on August 20-21, 2020. Figure IV-14 demonstrated highly elevated $PM_{2.5}$ concentrations at numerous nearby monitoring sites in the South Central Coast Air Basin on these dates, including two sites in San Luis Obispo County - Atascadero and San Luis Obispo-Higuera.[33] Figures IV-15 and IV-16 compared the diurnal pattern of $PM_{2.5}$ concentrations observed at Red Hills using nonregulatory Purple Air sensor data on August 20-21, 2020, to hourly diurnal $PM_{2.5}$ percentiles from August 2018-2019 Purple Air data.[34] Figures IV-20 and IV-21 provided this comparison using regulatory $PM_{2.5}$ data from the Atascadero – Lift Station #5 monitoring site from August 2015-2019 and August 20-21, 2020.[35] While the magnitude of concentrations measured by the Purple Air sensor located at Red Hills compared to those measured by the regulatory $PM_{2.5}$ Atascadero monitor vary substantially, the diurnal patterns measured on the exceedance days are nearly identical, and both the Purple Air sensor and the regulatory $PM_{2.5}$ monitor measured substantially above their respective 95th percentiles for all hours of August 20 and 21, 2020. The $PM_{2.5}$ concentration profiles observed at these monitors on August 20 and 21, 2020, reflect unusual spikes in $PM_{2.5}$ concentrations in the morning and night and sustained high $PM_{2.5}$ concentrations throughout the day, straying from the typical hourly $PM_{2.5}$ concentration profiles observed in the preceding years.

Additionally, Figure IV-30 displayed mapped smoke plumes associated with the CZU Lightning Complex, SCU Lightning Complex, LNU Lightning Complex, August Complex, North Complex, Dolan Fire, and other, smaller wildfires, generated using the National Aeronautics and Space Administration (NASA) GEOS-5 forward processing model.[36] The presence of a black carbon plume over Red Hills provides further support for wildfire emissions affecting the monitor, as fires that burn moist fuels at relatively low temperatures, e.g., forest fires, produce relatively higher amounts of black carbon.

Lastly, Figure IV-36 presented the aerosol optical depth and smoke surface concentrations over the western United States on August 21, 2020, as determined by the Navy Aerosol Analysis and Prediction System (NAAPS) Global Aerosol Model.[37] These model outputs predict the amount of aerosol and ground-level smoke concentrations. The high aerosol optical depth and smoke

[32] See demonstration, pp. 114-115.
[33] See demonstration, p. 121. Note that p. 121 of the demonstration shows a "SLO-Higuero" site. EPA believes this was intended to reference the San Luis Obispo-Higuera Street site, as listed on p. 15 of the demonstration.
[34] See demonstration, pp. 123-124.
[35] See demonstration, p. 126.
[36] See demonstration, pp. 131-132.
[37] See demonstration, pp. 137-138.

surface concentrations modeled over central California for August 21, 2020, provide further evidence that the Red Hills monitor was affected by wildfire smoke on this date.

Conclusion

The analyses included in the demonstration, specifically, comparison to historical concentrations and typical diurnal O_3 and $PM_{2.5}$ concentration profiles, Q/D analyses, HYSPLIT forward and backward trajectories, meteorological conditions, nonregulatory $PM_{2.5}$ monitoring data analysis, information from NASA GEOS-5 and the NAAPS Global Aerosol Model, and air quality district alerts and advisories, sufficiently demonstrate a clear causal relationship between the emissions generated by numerous wildfires in California in August 2020 including the CZU Lightning Complex, SCU Lightning Complex, River, Carmel, Dolan, and Hills fires, and the exceedances measured at the Red Hills monitoring site.

Table 3: Documentation of the Clear Causal Relationship criterion

Exceedance Date	Demonstration Citation	Quality of Evidence	Criterion Met?
August 20-21, 2020	Section III, "Narrative Conceptual Model": pp. 69-71, 74-77, 84-89, 97-98. "Clear Causal Relationship": pp. 102-138. Appendix C: pp. 169-177. Appendix D: pp. 188-245.	Sufficient	Yes

Not Reasonably Controllable or Preventable

The Exceptional Events Rule presumes that wildfire events on wildland are not reasonably controllable or preventable [40 CFR §50.14(b)(4)]. The demonstration provided evidence that the wildfire event meets definition of wildfire [40 CFR §50.1(n)]. Specifically, the demonstration included maps and descriptions of the wildfires along with figures showing wildfire boundaries overlaid upon land ownership and wildland-urban interface layers to demonstrate that the fires occurred on wildland or in the urban/wildland interface.[38] The demonstration described that CARB is not aware of any evidence clearly demonstrating that prevention or control efforts beyond those actually made would have been reasonable.[39] Therefore, the documentation provided sufficiently demonstrates that the event was not reasonably controllable and not reasonably preventable.

Table 4: Documentation of the Not Reasonably Controllable or Preventable criterion

Exceedance Date	Demonstration Citation	Quality of Evidence	Criterion Met?
August 20-21, 2020	"Narrative Conceptual Model": pp. 25-68. "Not Reasonably Controllable and/or Not Reasonably Preventable": p. 140.	Sufficient	Yes

Natural Event

The definition of "wildfire" at 40 CFR §50.1(n) states, "A wildfire that predominantly occurs on wildland is a natural event." As previously described, the demonstration included documentation

[38] See demonstration, pp. 66-68.
[39] See demonstration, p. 140.

that the event meets the definition of a wildfire and occurred predominantly on wildland and has therefore shown that the event was a natural event.

Table 5: Documentation of the Natural Event criterion

Exceedance Date	Demonstration Citation	Quality of Evidence	Criterion Met?
August 20-21, 2020	"Narrative Conceptual Model": pp. 66-68. "Not Reasonably Controllable and/or Not Reasonably Preventable": p. 140.	Sufficient	Yes

Schedule and Procedural Requirements

In addition to technical demonstration requirements, 40 CFR §50.14(c) and 40 CFR §51.930 specify schedule and procedural requirements an air agency must follow to request data exclusion. Table 6 outlines the EPA's evaluation of these requirements.

Table 6: Schedules and Procedural Criteria

	Reference	Demonstration Citation	Criterion Met?
Did the agency provide prompt public notification of the event?	40 CFR §50.14 (c)(1)(i)	"Narrative Conceptual Model": pp. 97-98; "Clear Causal Relationship": p. 140; Appendix B: pp. 154-155.	Yes
Did the agency submit an Initial Notification of Potential Exceptional Event and flag the affected data in the EPA's Air Quality System (AQS)?	40 CFR §50.14 (c)(2)(i)	Appendix A, pp. 145-149	Yes
Did the initial notification and demonstration submittals meet the deadlines for data influenced by exceptional events for use in initial area designations, if applicable? Or the deadlines established by the EPA during the Initial Notification of Potential Exceptional Events process, if applicable?	40 CFR §50.14 Table 2 40 CFR §50.14 (c)(2)(i)(B)	See email from Sylvia Vanderspek, CARB, to Gwen Yoshimura, EPA Region 9, dated March 16, 2021.	Yes

	Reference	Demonstration Citation	Criterion Met?
Was the public comment process followed and documented? • Did the agency document that the comment period was open for a minimum of 30 days? • Did the agency submit to the EPA any public comments received? • Did the state address comments disputing or contradicting factual evidence provided in the demonstration?	40 CFR §50.14 (c)(3)(v)	"Public Notification": p. 140; See letter from Michael Benjamin, CARB, to Matthew Lakin, dated December 8, 2021.	Yes
Has the agency met requirements regarding submission of a mitigation plan, if applicable?	40 CFR §51.930 (b)	NA	NA

Conclusion

The EPA has reviewed the documentation provided by CARB to support claims that smoke from wildfires throughout California, including the CZU Lightning Complex, SCU Lightning Complex, River, Carmel, Dolan, and Hills fires, caused exceedances of the 2015 8-hour O_3 NAAQS at the Red Hills monitoring site on August 20-21, 2020. The EPA has determined that the flagged exceedances at this monitoring site on these days satisfy the exceptional event criteria: the event was a natural event, which affected air quality in such a way that there exists a clear causal relationship between the event and the monitored exceedances, and was not reasonably controllable or preventable. The EPA has also determined that CARB has satisfied the schedule and procedural requirements for data exclusion.

ENCLOSURE: TECHNICAL SUPPORT DOCUMENT FOR EPA CONCURRENCE ON O_3 EXCEEDANCES MEASURED IN THE EASTERN PART OF SAN LUIS OBISPO COUNTY, CALIFORNIA ON SEPTEMBER 30 – OCTOBER 2, 2020 AS AN EXCEPTIONAL EVENT

On December 8, 2021, the California Air Resources Board (CARB) submitted an exceptional event demonstration for exceedances of the 2015 8-hour ozone (O_3) National Ambient Air Quality Standards (NAAQS) of 0.070 parts per million (ppm) that occurred at the Red Hills monitoring site on September 30 – October 2, 2020.[1] The demonstration submitted by CARB stated that the exceedances measured on September 30-October 2, 2020 were caused by multiple wildfires burning in Central and Southern California, namely the SQF Complex, LNU Lightning Complex, August Complex, North Complex, and Creek fires.[2] Under the Exceptional Events Rule, air agencies can request the exclusion of event-influenced data, and the EPA can agree to exclude these data, from the data set used for certain regulatory decisions. The remainder of this document summarizes the Exceptional Events Rule requirements, the event and the EPA's review process.

EXCEPTIONAL EVENTS RULE REQUIREMENTS

The EPA promulgated the Exceptional Events Rule in 2007, pursuant to the 2005 amendment of Clean Air Act (CAA) Section 319. In 2016, the EPA finalized revisions to the Exceptional Events Rule. The 2007 Exceptional Events Rule and 2016 Exceptional Events Rule revisions added sections 40 CFR §50.1(j)-(r); §50.14; and §51.930 to title 40 of the Code of Federal Regulations (CFR). These sections contain definitions, criteria for EPA approval, procedural requirements, and requirements for air agency demonstrations. The EPA reviews the information and analyses in the air agency's demonstration package using a weight of evidence approach and decides to concur or not concur. The demonstration must satisfy all of the Exceptional Events Rule criteria for the EPA to concur with excluding the air quality data from regulatory decisions.

Under 40 CFR §50.14(c)(3)(iv), the air agency demonstration to justify exclusion of data must include:

A. "A narrative conceptual model that describes the event(s) causing the exceedance or violation and a discussion of how emissions from the event(s) led to the exceedance or violation at the affected monitor(s);"

B. "A demonstration that the event affected air quality in such a way that there exists a clear causal relationship between the specific event and the monitored exceedance or violation;"

C. "Analyses comparing the claimed event-influenced concentration(s) to concentrations at the same monitoring site at other times" to support requirement (B) above;

[1] "Exceptional Events Demonstration for Ozone Exceedances Southern California 2020 Wildfire Events," (December 8, 2021) ("demonstration")." The demonstration also includes exceptional events analyses for other California nonattainment areas for the 2008 and/or 2015 NAAQS. The EPA's evaluation of the information presented in the demonstration is reflected in five separate technical support documents.

[2] See demonstration, p. 69.

D. "A demonstration that the event was both not reasonably controllable and not reasonably preventable;" and

E. "A demonstration that the event was a human activity that is unlikely to recur at a particular location or was a natural event."[3]

In addition, the air agency must meet several procedural requirements, including:

1. submission of an Initial Notification of Potential Exceptional Event and flagging of the affected data in the EPA's Air Quality System (AQS) as described in 40 CFR §50.14(c)(2)(i),

2. completion and documentation of the public comment process described in 40 CFR §50.14(c)(3)(v), and

3. implementation of any relevant mitigation requirements as described in 40 CFR §51.930.

For data influenced by exceptional events to be excluded from use in initial area designations, air agencies must also meet the initial notification and demonstration submission deadlines specified in Table 2 to 40 CFR §50.14. We include below a summary of the Exceptional Events Rule criteria, including those identified in 40 CFR §50.14(c)(3)(iv).

Regulatory Significance

The 2016 Exceptional Events Rule includes regulatory language that applies the provisions of CAA section 319 to a specific set of regulatory actions. As identified in 40 CFR §50.14(a)(1)(i), these regulatory actions include initial area designations and redesignations; area classifications; attainment determinations (including clean data determinations); attainment date extensions; findings of State Implementation Plan (SIP) inadequacy leading to a SIP call; and other actions on a case-by-case basis as determined by the Administrator. Air agencies and the EPA should discuss the regulatory significance of an exceptional events demonstration during the Initial Notification of Potential Exceptional Event prior to the air agency submitting a demonstration for the EPA's review.

Narrative Conceptual Model

The 2016 Exceptional Events Rule directs air agencies to submit, as part of the demonstration, a narrative conceptual model of the event that describes and summarizes the event in question and provides context for analyzing the required statutory and regulatory technical criteria. Air agencies may support the narrative conceptual model with summary tables or maps. For wildfire O_3 events, the EPA recommends that the narrative conceptual model also discuss the interaction of emissions, meteorology, and chemistry of event and non-event O_3 formation in the area, and,

[3] A natural event is further described in 40 CFR 50.1(k) as "an event and its resulting emissions, which may recur at the same location, in which human activity plays little or no direct causal role. For purposes of the definition of a natural event, anthropogenic sources that are reasonably controlled shall be considered to not play a direct role in causing emissions."

under 40 CFR §50.14(a)(1)(i), must describe the regulatory significance of the proposed data exclusion.

Clear Causal Relationship and Supporting Analyses

The EPA considers a variety of evidence when evaluating whether there is a clear causal relationship between a specific event and the monitored exceedance or violation. For wildfire O_3 events, air agencies should compare the O_3 data requested for exclusion with seasonal and annual historical concentrations at the air quality monitor to establish a clear causal relationship between the event and monitored data. In addition to providing this information on the historical context for the event-influenced data, air agencies should further support the clear causal relationship criterion by demonstrating that the wildfire's emissions were transported to the monitor, that the emissions from the wildfire influenced the monitored concentrations, and, in some cases, air agencies may need to provide evidence of the contribution of the wildfire's emissions to the monitored O_3 exceedance or violation.

For wildfire O_3 events, the EPA has published a guidance document that provides three different tiers of analyses that apply to the "clear causal relationship" criterion within an air agency's exceptional events demonstration.[4] This tiered approach recognizes that some wildfire events may be more clear and/or extreme and, therefore, require relatively less evidence to satisfy the rule requirements. If a wildfire/O_3 event satisfies the key factors for either Tier 1 or Tier 2 clear causal analyses, then those analyses are the only analyses required to support the clear causal relationship criterion within an air agency's demonstration for that particular event. Other wildfire/O_3 events will be considered based on Tier 3 analyses.

- Tier 1: Wildfires that clearly influence monitored O_3 exceedances or violations when they occur in an area that typically experiences lower O_3 concentrations.
    - *Key Factor*: seasonality and/or distinctive level of the monitored O_3 concentration. The event-related exceedance occurs during a time of year that typically has no exceedances, or is clearly distinguishable (*e.g.*, 5-10 parts per billion (ppb) higher) from non-event exceedances.
    - In these situations, O_3 impacts should be accompanied by clear evidence that the wildfire's emissions were transported to the location of the monitor.

- Tier 2: The wildfire event's O_3 influences are higher than non-event related concentrations, and fire emissions compared to the fire's distance from the affected monitor indicate a clear causal relationship.
    - *Key Factor 1*: fire emissions and distance of fire(s) to affected monitoring site location(s). Calculated fire emissions of nitrogen oxides (NO_x) and reactive-volatile organic compounds (VOC) in tons per day (Q) divided by the distance from the fire to the monitoring site (D) should be equal to or greater than 100 tons per day/kilometers ($Q/D \geq 100$ tpd/km). The guidance document provides additional information on the calculation of Q/D.

[4] "Guidance on the Preparation of Exceptional Events Demonstrations for Wildfire Events that May Influence Ozone Concentrations" (September 2016) ("wildfire O_3 guidance document").

- *Key Factor 2*: comparison of the event-related O_3 concentration with non-event related high O_3 concentrations. The exceedance due to the exceptional event:
  - is in the 99th or higher percentile of the 5-year distribution of O_3monitoring data, OR
  - is one of the four highest O_3 concentrations within 1 year (among those concentrations that have not already been excluded under the Exceptional Events Rule, if any).
- In addition to the analysis required for Tier 1, the air agency should supply additional evidence to support the weight of evidence that emissions from the wildfire affected the monitored O_3 concentration.

- Tier 3: The wildfire does not fall into the specific scenarios (i.e. does not meet the key factors) that qualify for Tier 1 or Tier 2, but the clear causal relationship criterion can still be satisfied by a weight of evidence showing.
  - In addition to the analyses required for Tier 1 and Tier 2, an air agency may further support the clear causal relationship with additional evidence that the fire emissions caused the O_3 exceedance.

Not Reasonably Controllable or Preventable

The Exceptional Events Rule requires that air agencies establish that the event be both not reasonably controllable and not reasonably preventable at the time the event occurred. This requirement applies to both natural events and events caused by human activities; however, it is presumed that wildfires on wildland will satisfy both factors of the "not reasonably controllable or preventable" element unless evidence in the record clearly demonstrates otherwise.[5]

Natural Event

According to the CAA and the Exceptional Events Rule, an exceptional event must be "an event caused by human activity that is unlikely to recur at a particular location *or* a natural event" (emphasis added). The 2016 Exceptional Events Rule includes in the definition of wildfire that "[a] wildfire that predominantly occurs on wildland is a natural event." Once an agency provides evidence that a wildfire on wildland occurred and demonstrates that there is a clear causal relationship between the measurement under consideration and the event, the EPA expects minimal documentation to satisfy the "human activity that is unlikely to recur at a particular location or a natural event" element. The EPA will address wildfires on other lands on a case-by-case basis.

EPA REVIEW OF EXCEPTIONAL EVENTS DEMONSTRATION

On March 16, 2021, CARB submitted an Initial Notification of a potential Exceptional Event for three exceedances of the 2015 8-hour O_3 NAAQS that occurred at the Red Hills monitoring site

[5] A wildfire is defined in 40 CFR 50.1(n) as "any fire started by an unplanned ignition caused by lightning; volcanoes; other acts of nature; unauthorized activity; or accidental, human-caused actions, or a prescribed fire that has developed into a wildfire. A wildfire that predominantly occurs on wildland is a natural event." Wildland is defined in 40 CFR 50.1(o) as "an area in which human activity and development are essentially non-existent, except for roads, railroads, power lines, and similar transportation facilities. Structures, if any, are widely scattered."

within San Luis Obispo County, California (CA) between September 30 – October 2, 2020.[6] On December 8, 2021, CARB submitted an exceptional event demonstration for three exceedances of the 2015 8-hour O_3 NAAQS that occurred at the Red Hills monitoring site within San Luis Obispo County, CA between September 30 – October 2, 2020.[7]

Regulatory Significance

The EPA determined that data exclusion of certain exceedances referenced in the Initial Notification may have a regulatory significance for a determination of attainment by the attainment date for the San Luis Obispo (Eastern part), CA Marginal nonattainment area for the 2015 O_3 NAAQS and worked with CARB to identify the relevant exceedances and monitoring sites affected.[8] Table 1 summarizes the exceedances measured at the Red Hills monitor in September and October 2020 that CARB included in the demonstration.

Table 1:2015 8-hour O_3 NAAQS Exceedance Summary

Exceedance Date	Monitoring Site Name	AQS ID	2015 8-hour Avg. (ppm)
September 30, 2020	Red Hills	06-079-8005	0.075
October 1, 2020	Red Hills	06-079-8005	0.081
October 2, 2020	Red Hills	06-079-8005	0.081

Narrative Conceptual Model

The demonstration submitted by CARB provided a narrative conceptual model in the "Overview/Introduction," "Background," and "Narrative Conceptual Model" sections of the demonstration to describe how emissions from the SQF Complex, LNU Lightning Complex, August Complex, North Complex, and Creek fires in California caused the O_3 exceedances at the Red Hills monitoring site. The demonstration addressed the regulatory significance of the exceptional event in "Overview/Introduction" by stating that the exclusion of wildfire events in 2018 and 2020 would affect a determination of attainment for the San Luis Obispo (Eastern Part), CA Marginal nonattainment area for the 2015 O_3 NAAQS.[9]

The "Overview/Introduction" and "Background" chapters provided information supporting the narrative conceptual model including characteristics of the nonattainment area, such as geography, topography, meteorology, the ambient O_3 monitoring network, typical non-event O_3 formation conditions and patterns, seasonal O_3 variations, and emissions of O_3 precursors.[10]

The narrative conceptual model also described characteristics of the event. This included a summary of the occurrences of wildfires in California and specific descriptions of individual wildfires that generated smoke contributing to O_3 exceedances at the Red Hills monitoring site from September 30 – October 2, 2020.[11] The demonstration provided tables for the actively burning fires during the time of the exceedances which include the fire name, source, start date,

[6] See email from Sylvia Vanderspek, CARB, to Gwen Yoshimura, EPA Region 9, dated March 16, 2021.
[7] See letter from Michael Benjamin, CARB, to Matthew Lakin, EPA Region 9, dated December 8, 2021.
[8] See letter from Elizabeth Adams, EPA Region 9, to Sylvia Vanderspek, CARB, dated August 27, 2021.
[9] See demonstration, pp. 2, 4-6.
[10] See demonstration pp. 7-9, 13-19, 21-22.
[11] See demonstration pp. 23-26.

containment date, location, and total acreage burned along with maps of the fire perimeters.[12] The narrative conceptual model also included figures displaying meteorological conditions on the dates of the fires and Hybrid Single Particle Lagrangian Integrated Trajectory (HYSPLIT) modeling results. The HYSPLIT trajectory modeling results were presented with satellite imagery, National Oceanic and Atmospheric Association (NOAA) Hazard and Mapping System (HMS) satellite-derived smoke layers, and meteorological analysis to support that wildfire emissions were transported to the Red Hills monitoring site in the South Central Coast Air Basin on the exceptional event dates requested for exclusion. Along with these graphics, the narrative conceptual model included descriptions of how meteorological conditions (atmospheric pressure maps, temperature, winds, and precipitation) affected the behavior of air and smoke in the areas of the wildfires on September 30 – October 2, 2020.[13]

The narrative conceptual model included charts showing event related concentrations and long-term trends. The concentrations of 1-hour O_3 measured at the Red Hills monitoring site and 1-hour particulate matter less than or equal to 2.5 microns in aerodynamic diameter ($PM_{2.5}$) measured using a nonregulatory Purple Air sensor at Red Hills from September 27, 2020, through October 5, 2020, are plotted in Figure III-32. The concentrations of 1-hour O_3 measured at the Red Hills monitoring site and 1-hour $PM_{2.5}$ measured using a regulatory monitor at the Atascadero-Lift Station #5 from August 1, 2020 to November 1, 2020 are plotted in Figure III-33. Figure III-32 shows dramatic increases in $PM_{2.5}$ later in the day on September 30 with sustained elevated concentrations of both pollutants through October 4, 2020. The demonstration stated that elevated $PM_{2.5}$ concentrations support the presence of wildfire smoke. The demonstration also included a chart of 8-hour O_3 design values at the Red Hills monitoring site from 2009 to 2020 with a trendline to suggest that the O_3 concentrations observed in 2020 strayed from the overall downwards trend. The demonstration suggests that the departure of the September 30 – October 2, 2020 monitored O_3 concentrations at Red Hills from the trend observed from 2009 to 2020 could have been influenced by smoke from fires.[14]

The narrative conceptual model also included daily meteorological data such as temperatures and wind speeds along with 1-hr and 8-hr O_3 concentrations from the Red Hills monitoring site to show that weather patterns observed at the Red Hills monitoring site on exceptional event days were not generally more favorable for O_3 formation than on non-event days during the September 27 – October 4, 2020 period.[15] The demonstration concluded that O_3 directly related to wildfire smoke influenced the exceedances rather than unusual weather.[16] The narrative conceptual model included descriptions of media reports and other social media coverage of the 2020 wildfires throughout California that influence the Red Hills monitor from September 30 – October 2, 2020.[17]

Overall, the demonstration contained the elements required for inclusion in the conceptual model portion of the exceptional events demonstration.

[12] See demonstration pp. 27-66.
[13] See demonstration, pp. 78-83.
[14] See demonstration, pp. 84-88.
[15] See demonstration pp. 94-95.
[16] See demonstration pp. 93-97.
[17] See demonstration, pp. 269-272, 288-294.

Table 2: Documentation of the Narrative Conceptual Model

Exceedance Date	Demonstration Citation	Quality of Evidence	Criterion Met?
September 30 – October 2, 2020	"Overview/Introduction": pp. 2-6. "Background": pp. 7-9, 13-19, 21-22. "Narrative Conceptual Model": pp. 23-101.	Sufficient	Yes

Clear Causal Relationship

The demonstration included several analyses to support a clear causal relationship between the wildfire event and the monitored exceedances. These analyses were presented in the "Clear Causal Relationship" section of the demonstration.

Comparison with historical concentrations

The demonstration included a comparison with historical concentrations, as required by 40 CFR §50.14(c)(3)(iv)(C). The demonstration compared O_3 concentrations at the Red Hills monitoring site on the 2020 wildfire exceptional event days to historical non-event O_3 concentrations from 2015-2020.[18] This included a graph of daily maximum 8-hour average concentrations over the six-year period by day of the year, along with the level of the NAAQS and the 99th percentile value at the site. The concentrations measured on September 30-October 2, 2020 were above the level of the NAAQS and the 99th percentile value, but within the range of other non-event exceedances measured at the site.

Tier 1: Key Factor

To meet the key factor for a Tier 1 analysis, exceedances should be clearly higher than other non-event related exceedances, or occur during a time of year that typically experiences no exceedances. The three exceedances from September 30-October 2, 2020 identified in the demonstration occurred within the O_3 season and did not exceed non-event exceedance concentrations by at least 5 ppb. Therefore, the exceedances do not meet the Tier 1 Key Factor and additional evidence beyond a Tier 1 analysis is needed to support the clear causal relationship.

Tier 2: Key Factors

The demonstration included an evaluation of the Tier 2 Key Factors. For Tier 2 Key Factor 1, the demonstration provided an analysis of fire emissions (Q) and distance (D) of the wildfires to the monitoring site locations. The Q/D value is generally calculated by dividing wildfire emissions (in tpd) by the distance between the wildfire and the monitoring site (in kilometers [km]). Daily Q/D values were calculated by the EPA using daily wildland fire emissions input files originally created for the Community Multiscale Air Quality (CMAQ) modeling system. The resulting calculations were shared with CARB to assist in demonstration development. CMAQ input files included daily total emissions of nitrogen oxide (NO), nitrogen dioxide (NO_2), and reactive organic gases (ROG) at release points corresponding to wildfire locations. Q/D was calculated for each CMAQ input release point by calculating the distance between release point locations and gridded receptor locations and dividing the associated fire's daily total emissions by this distance. An aggregated daily Q/D was then calculated by summing the individual Q/D values for each release point. An "effective Q/D" value was calculated at monitoring site receptor

[18] See demonstration, p. 104.

locations by accounting for periods where multiple days of wildfire smoke buildup impacted the monitoring site for up to three total days; the dates to include in each daily "effective Q/D" were based on meteorology and transport analyses, with the rationale further outlined in the demonstration.[19] The distance-weighted sums for September 30-October 2, 2020 are 42, 60, and 56 tpd of NO_x and VOC per km respectively, which are below the Tier 2 Key Factor 1 screening value of 100 tons per day of NO_x and VOC per km. Therefore, the event exceedances do not meet Tier 2 Key Factor 1.

For Tier 2 Key Factor 2, the demonstration included evidence that the exceedances are at or above the 99th percentile from the past five years of O_3 season data (2015-2019) or among the four highest concentrations measured at the site in 2020. In the demonstration, CARB determined an "adjusted 4th high" corresponding to the 4th highest non-event exceedance monitored in 2020, excluding the exceedances for which CARB submitted an exceptional events demonstration.[20] CARB stated that dates impacted by exceptional events should not count against the tally of the four highest O_3 concentrations measured in 2020 because these exceedances were caused by contributions from wildfire emissions.[21] This rationale is supported given that the purpose of the test is to show that the exceedance is high compared to non-event data. Since the excluded dates are all included in the demonstration being evaluated for the San Luis Obispo (Eastern part), CA Marginal nonattainment area, each individual date would not count towards the four highest concentrations if concurred on by the EPA.[22] As shown in Table IV-3 of the demonstration, the monitored O_3 concentrations on the three days (September 30-October 2, 2020) requested as exceptional events exceed the adjusted 4th high O_3 concentration at the Red Hills monitoring site in 2020.[23] All three dates requested for exclusion were also above the 99th percentile value of 71 ppb during the five-year period for the site. Therefore, the event exceedances meet Tier 2 Key Factor 2.

Based on the analysis of the Key Factors for Tier 2, the EPA's wildfire O_3 guidance document indicates that a Tier 3 analysis is appropriate for this event. As described below, the demonstration included the required elements for a clear causal relationship analysis based on the EPA's wildfire O_3 guidance document. This includes evidence to support that (1) wildfire emissions were transported from the wildfire to the monitor; (2) wildfire emissions affected the monitor; and (3) wildfire emissions caused the O_3 exceedances.

Tier 3 analysis: Evidence of transport of wildfire emissions from the wildfire to the monitor

The demonstration presented analyses conducted using backward trajectory and forward trajectory modeling presented in the "Narrative Conceptual Model" chapter of the demonstration.[24] HYSPLIT back trajectories originating at the monitor location at three elevations (1000 meters (m), 500m, and 100m) show the likely path of air parcels for each exceedance day, 36 hours prior to the first hour of the exceeding 8-hour time period and 36 hours prior to the hour of maximum concentrations within that 8-hour time period; Figure III-31 overlays one set of these back trajectories on NOAA HMS Fire and Smoke Product imagery.

[19] See demonstration, pp. 108-109.
[20] See demonstration, pp. 111-112.
[21] See demonstration, p. 111.
[22] The submittal document from CARB also includes analyses for exceptional event dates that occurred at the Red Hills monitoring site on August 20-21, 2020. These exceptional event dates are evaluated by the EPA in a separate TSD.
[23] See demonstration, pp. 112-113.
[24] See demonstration, pp. 82-83, Appendix D, pp. 230-238, 241-242.

HYSPLIT forward trajectories beginning at the wildfire locations at the same three elevations show the most likely center path air parcels travelled for 36 to 48 hours, starting at 4:00 PM PST the day before the exceedances and at 4:00 AM PST the day of the exceedances; Figure III-30 overlays one set of these forward trajectories on satellite imagery to provide a visual analysis of whether smoke emitted from the fires may have impacted the Red Hills monitoring site. The forward trajectories pathways from the North Complex, SQF Complex, and Creek fire generally approach eastern San Luis Obispo County, where the Red Hills monitor is located, and the backward trajectories from September 30-October 2, 2020 presented in Appendix D of the demonstration pass through areas of heavy smoke and occasionally near fire locations. Overall, the backward and forward trajectory analyses support that the wildfire emissions were transported to the Red Hills monitoring site on September 30-October 2, 2020.[25]

Smoke Text Product issued by NOAA also provided descriptive evidence that smoke was prevalent throughout southern California during the September 30 – October 2, 2020 exceedance days at the Red Hills monitor.[26]

The back trajectory and forward trajectory analyses, along with satellite observations of smoke in the area, support that the wildfire emissions were transported to the Red Hills monitoring site on the days requested for exclusion as exceptional events.

Tier 3 analysis: Evidence that the wildfire emissions affected the monitor

The demonstration provided O_3 concentrations and diurnal profiles along with concentrations and diurnal profiles of smoke-related pollutants to support that wildfire emissions affected air quality at the Red Hills monitoring site.

The demonstration included figures comparing the daily diurnal pattern of 1-hour O_3 concentrations on each exceptional event day at the Red Hills monitoring site to hourly diurnal O_3 percentiles from 2015-2019 and included the 5th, 50th, and 95th percentile values.[27] These figures show that O_3 diurnal patterns were abnormal compared to the percentiles of the previous years; abnormally elevated O_3 concentrations were sustained over multiple days, with every 1-hour concentration equal to or above the 95th percentile from 4:00 PM on September 30, 2020 through 11:00 PM on October 2, 2020. In addition, unusual timing of spikes and dips in O_3 concentrations were also seen, with several peaks occurring at times when photochemistry is not typically active, such as overnight. For example, the September 30, 2020 exceedance began with unusually elevated O_3 concentrations during the overnight hour of 11:00 PM PST and carried through the early morning hours of October 2, 2020.[28] These diurnal ozone figures support that

[25] HYSPLIT presents results in UTC, which is shown at the top of the HYSPLIT figures included in the demonstration. Times in the demonstration appear to be given in PST and UTC. In September and October 2020, the local time zone for Ventura County was Pacific Daylight Time (PDT). However, for consistency with the demonstration, this TSD will use PST. The offset from PDT to PST is one hour later (*i.e.*, 12:00 PM in PST is 1:00 PM in PDT).

[26] See demonstration, Appendix E. pp. 245-249.

[27] See demonstration, pp. 116-117.

[28] Note that the exceedance reported for September 30, 2020 includes the 11:00 PM PST concentration from September 30, 2020, along with the concentrations measured between 12:00 AM and 6:00 AM on October 1, 2020. While other hourly concentrations above the level of the NAAQS were reported earlier in the day on September 30, 2020, those concentrations do not contribute to an 8-hour average above the level of the NAAQS per the calculations described in 40 CFR 50, Appendix U, and thus this TSD is not evaluating whether those earlier concentrations were caused by an exceptional event since they do not contribute to an exceedance of the NAAQS.

the September 30 – October 2, 2020 at the Red Hills monitoring site were unusual when compared to historical patterns.

The demonstration also included plots of daily $PM_{2.5}$ concentrations at the Red Hills monitoring site as well as charts of wildfire-related pollutant concentrations at nearby monitoring sites. In 2018, a nonregulatory Purple Air $PM_{2.5}$ sensor was established at the Red Hills monitoring site to measure $PM_{2.5}$ concentrations. Figures IV-17 through IV-20 of the demonstration provide hourly percentiles for 1-hour $PM_{2.5}$ data from October 2019 compared with the $PM_{2.5}$ concentrations from September 30 – October 2, 2020 from the Purple Air sensor at Red Hills.[29] In addition, Figures IV-22 through IV-24 of the demonstration show hourly percentiles for 1-hour $PM_{2.5}$ for September 2015-2019 and October 2015-2019 from the regulatory $PM_{2.5}$ monitor located at the Atascadero – Lift Station #5 monitoring site.[30] The Atascadero – Lift Station #5 monitoring site is approximately 35 miles to the west of the Red Hills monitoring site.[31] While the magnitude of concentrations measured by the Purple Air sensor located at Red Hills compared to those measured by the regulatory $PM_{2.5}$ Atascadero monitor vary substantially, the diurnal patterns measured on the exceedance days are nearly identical. From 6:00 PM on September 30, 2020 through 11:00 PM on October 2, 2020, all hours measured by the sensor and nearly all hours measured by the Atascadero regulatory $PM_{2.5}$ monitor were above their respective 95th percentile values. The highly elevated hourly $PM_{2.5}$ concentrations observed by the Purple Air sensor and regulatory Atascadero monitor provide evidence that wildfire emissions affected the Red Hills monitoring site during the September 30 – October 2, 2020 exceedances.

The O_3 hourly concentration and percentile profile analysis and $PM_{2.5}$ hourly concentration and percentile profile analysis support that wildfire emissions reached the ground and affected measurements at the Red Hills monitoring site on September 30 – October 2, 2020.

Tier 3 analysis: Additional evidence that the wildfire emissions caused the O_3 exceedance

The demonstration included additional evidence to support that the wildfire emissions specifically affected O_3 concentrations at the exceeding Red Hills monitoring site and caused the O_3 exceedances. The demonstration included analysis of coincident increases in O_3 and $PM_{2.5}$ concentrations, National Weather Service (NWS) area forecast discussions, and Navy Aerosol Analysis and Prediction System (NAAPS) modeling.

The demonstration included hourly $PM_{2.5}$ concentrations from the nonregulatory Purple Air sensor located at the Red Hills monitoring site and the regulatory $PM_{2.5}$ monitor located at the Atascadero – Lift Station #5 monitoring site. These data were overlaid with O_3 concentrations measured at the Red Hills site, showing that large increases in $PM_{2.5}$ coincided with elevated O_3 concentrations during the period requested for exclusion. The unusual O_3 diurnal patterns coincident with elevated concentrations of $PM_{2.5}$ at the nonregulatory Purple Air sensor and regulatory Atascadero $PM_{2.5}$ monitor supports that the present of smoke impacted the Red Hills monitor during the September 30 – October 2, 2020 exceedance days.[32]

[29] See demonstration, pp. 124-125.
[30] See demonstration, pp. 127-128.
[31] See demonstration, p. 84.
[32] See demonstration, pp. 85-87.

As additional evidence to support that wildfire emissions affected the Red Hills monitoring site, the demonstration included area forecast discussions issued by the NWS Los Angeles/Oxnard office between September 28 – October 4, 2020 related to wildfire smoke. The NWS area forecast discussion describes dense fog and haze from wildfires around the San Luis Obispo area on September 30, 2020, and thinner, but persistent layers of smoke in San Luis Obispo County for October 1-4, 2020.[33] The demonstration also includes excerpts from news media including: a KSBY article stating that air quality alerts were issued for San Luis Obispo County on October 1, 2020 and describing "a blanket of smoke" over the area, an article published by the San Luis Obispo Tribune discussing the Dolan Fire, an article published by The Guardian on October 2, 2020 warning of smoke choking California, and a news report on the damage caused by the Bobcat Fire published by KTLA on October 3, 2020.[34]

Lastly, products (e.g., aerosol optical depth (AOD), surface smoke concentration) derived from the NAAPS Global Aerosol Model were presented for each day at both 5:00 AM PST and 5:00 PM PST for September 30 – October 4, 2020. The total optical depth and surface smoke concentration maps show widespread smoke impacting California, including San Luis Obispo during the September 30 – October 2, 2020 timeframe. Based on particle size, the NAAPS model identified smoke as the source of the particles.[35]

Overall, the correlation between elevated $PM_{2.5}$ and O_3 concentrations during the event period, special weather statements, and NAAPS modeling results provide additional evidence that wildfire emissions from the wildfires burning in Central and Southern California caused the O_3 exceedances observed on September 30 – October 2, 2020.

Conclusion

The analyses included in the demonstration, specifically, comparison to historical concentrations and typical diurnal O_3 and $PM_{2.5}$ concentration profiles, Q/D analyses, HYSPLIT forward and backward trajectories, NOAA HMS fire and smoke product imagery, nonregulatory $PM_{2.5}$ monitoring data analysis, NWS Area Forecast Discussions, and the NAAPS Global Aerosol Model, sufficiently demonstrate a clear causal relationship between the emissions generated by the SQF Complex, LNU Lightning Complex, August Complex, North Complex, and Creek fires and the exceedances measured at the Red Hills monitoring site.

Table 3: Documentation of the Clear Causal Relationship criterion

Exceedance Date	**Demonstration Citation**	**Quality of Evidence**	**Criterion Met?**
September 30 – October 2, 2020	"Narrative Conceptual Model": pp. 78-89 "Clear Causal Relationship": pp. 102-139 Appendix C: pp. 181-184 Appendix D: pp. 188-245 Appendix E: pp. 254-259	Sufficient	Yes

[33] See demonstration, Appendix C, pp. 180-187.
[34] See demonstration, Appendix F, pp. 267-272.
[35] See demonstration, Appendix E, pp. 254-259.

Not Reasonably Controllable or Preventable

The Exceptional Events Rule presumes that wildfire events on wildland are not reasonably controllable or preventable [40 CFR §50.14(b)(4)]. The demonstration provided evidence that the wildfire event meets definition of wildfire [40 CFR §50.1(n)]. Specifically, the demonstration included maps and descriptions of the wildfires, along with figures showing wildfire boundaries overlaid upon land ownership and wildland-urban interface layers to demonstrate that the fires occurred on wildland or in the urban/wildland interface.[36] The demonstration described that CARB is not aware of any evidence clearly demonstrating that prevention or control efforts beyond those actually made would have been reasonable.[37] Therefore, the documentation provided sufficiently demonstrates that the event was not reasonably controllable and not reasonably preventable.

Table 4: Documentation of the Not Reasonably Controllable or Preventable criterion

Exceedance Date	Demonstration Citation	Quality of Evidence	Criterion Met?
September 30 – October 2, 2020	"Narrative Conceptual Model": pp. 25-68 "Not reasonably Controllable and/or Not Reasonably Preventable": p. 140	Sufficient	*Yes*

Natural Event

The definition of "wildfire" at 40 CFR §50.1(n) states, "A wildfire that predominantly occurs on wildland is a natural event." As previously described, the demonstration included documentation that the event meets the definition of a wildfire and occurred predominantly on wildland and has therefore shown that the event was a natural event.

Table 5: Documentation of the Natural Event criterion

Exceedance Date	Demonstration Citation	Quality of Evidence	Criterion Met?
September 30 – October 2, 2020	"Narrative Conceptual Model": pp. 67-68 "Natural Event/Human Activity Unlikely to Recur": p. 140	Sufficient	Yes

Schedule and Procedural Requirements

In addition to technical demonstration requirements, 40 CFR §50.14(c) and 40 CFR §51.930 specify schedule and procedural requirements an air agency must follow to request data exclusion. Table 6 outlines the EPA's evaluation of these requirements.

[36] See demonstration, pp. 67-68.
[37] See demonstration, p. 140.

Table 6: Schedules and Procedural Criteria

	Reference	Demonstration Citation	Criterion Met?
Did the agency provide prompt public notification of the event?	40 CFR §50.14 (c)(1)(i)	"Public Notification": p. 140 Appendix F: pp. 269-272.	Yes
Did the agency submit an Initial Notification of Potential Exceptional Event and flag the affected data in the EPA's Air Quality System (AQS)?	40 CFR §50.14 (c)(2)(i)	Appendix A: pp. 145-149	Yes
Did the initial notification and demonstration submittals meet the deadlines for data influenced by exceptional events for use in initial area designations, if applicable? Or the deadlines established by the EPA during the Initial Notification of Potential Exceptional Events process, if applicable?	40 CFR §50.14 Table 2 40 CFR §50.14 (c)(2)(i)(B)	See email from Sylvia Vanderspek, CARB to Gwen Yoshimura, EPA Region 9, dated March 16, 2021.	Yes
Was the public comment process followed and documented? • Did the agency document that the comment period was open for a minimum of 30 days? • Did the agency submit to the EPA any public comments received? • Did the state address comments disputing or contradicting factual evidence provided in the demonstration?	40 CFR §50.14 (c)(3)(v)	"Public Notification": p. 140; See letter from Michael Benjamin, CARB, to Matthew Lakin, dated December 8, 2021	Yes
Has the agency met requirements regarding submission of a mitigation plan, if applicable?	40 CFR §51.930 (b)	NA	NA

Conclusion

The EPA has reviewed the documentation provided by CARB to support claims that smoke from wildfires burning in Central and Southern California, namely the SQF Complex, LNU Lightning Complex, August Complex, North Complex, and Creek fires, caused exceedances of the 2015 8-hour O_3 NAAQS at the Red Hills monitoring site between September 30 – October 2, 2020. The EPA has determined that the flagged exceedances at this monitoring site on these days satisfy the exceptional event criteria: the event was a natural event, which affected air quality in such a way that there exists a clear causal relationship between the event and the monitored exceedances, and was not reasonably controllable or preventable. The EPA has also determined that CARB has satisfied the schedule and procedural requirements for data exclusion.